Declaration of Robert Smith-Gillespie in Support of
Petition for *Inter Partes* Review of
U.S. Patent No. 8,854,595

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD AND SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioners,

v.

MANUFACTURING RESOURCES INTERNATIONAL, INC.,
Patent Owner.

IPR2023-00199

U.S. Patent No. 8,854,595

Issue Date: October 7, 2014

Title: CONSTRICTED CONVECTION COOLING SYSTEM FOR AN ELECTRONIC DISPLAY

DECLARATION OF ROBERT SMITH-GILLESPIE IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,854,595

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I, Robert Smith-Gillespie, declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

A. Introduction

1. I have been retained by Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, "Samsung" or "Petitioners") as a technical expert witness in connection with the Petition for *Inter Partes* Review of U.S. Patent No. 8,854,595 ("'595 patent"). The statements set forth in this declaration are based on my own personal knowledge. I am being compensated at my usual rate, which is $350 per hour, for the time spent preparing this declaration, and my compensation is not contingent on the outcome of any matter or any of the opinions provided below. I have no financial interest in this matter.

2. I understand that the '595 patent issued on October 7, 2014 from U.S. Application No. 12/411,925, naming William Dunn as inventor. I have been advised and it is my understanding that the earliest provisional priority date of the '595 patent is March 3, 2008, the filing date of Provisional Application No. 61/033,064, to which the '595 patent claims priority. For purposes of my analysis herein, I have used this date as the relevant time period.

3. I have been asked by Petitioners to offer opinions regarding the state of the art in the field of cooling electronic display equipment prior to March 3, 2008.

I have been asked to provide my opinion concerning the question of whether the devices described in claims 1, 4 and 7-8 of the ’595 patent were novel and/or would have been unobvious to a person of ordinary skill in the art (“POSITA”) by March 3, 2008.

4. In preparing this Declaration, I have reviewed the ’595 patent, its prosecution history, and each of the documents I reference herein. In reaching my opinions, I have relied upon my experience in the field and have also considered the viewpoint of a POSITA at the time of the ’595 patent’s priority date. As explained below, I am familiar with the level of skill of a POSITA regarding the technology at issue as of that time frame.

5. I would and could competently testify to the matters set forth in this Declaration if called upon to do so.

B. Qualifications and Experience

6. My background includes roughly 35 years of professional experience in the field of illuminated products including LCD displays and backlighting, LED illuminated consumer products, LED general lighting devices and large area LED display products. I am currently working in a consulting role as a manufacturing systems engineer for Alveo Technologies providing process development expertise for micro-fluidic diagnostic product manufacturing.

7. I received a B.A. in Physics in 1981 from the State University of New York, Plattsburgh, and a B.S. in Mechanical Engineering from Arizona State University in 1989. More recently, I received a Master of Systems Engineering degree from Embry-Riddle Aeronautical University (Oct. 2021). Additionally, I completed several continuing education courses related to optical illuminated systems. These include a UCLA Extension Short Course in 1993 or 1994 on Photometry and Colorimetry & Flat Panel Displays, Optical System Analysis with ASAP optical analysis software by Breault Research Organization in 1996, and a short course on LCD physics and materials at the Kent State University in 1998.

8. My first role involving display products was as a Manufacturing Engineer for Sperry Aerospace Corporation from 1985 through 1987. Sperry was purchased by Honeywell Inc., and I continued at Honeywell's Air Transport Systems Division until 1989. In 1989, I moved into the Flight Deck Packaging group as a Sr. Project Engineer where I was responsible for illuminated controls (switches, lighted panels, LED annunciators and numeric LCD modules). I continued at Honeywell through 1997 working as a Principal Engineer where I was responsible for mechanical and optical designs of the primary displays on the Boeing 777 aircrafts.

9. From 1997 through 1999, I worked as Technical Specialist, Displays at Three-Five Systems, Inc., an original design manufacturer of handheld and small

equipment LCD displays. My role focused on integrating LCD cells with backlights and mechanical structures for various custom LCDs into consumer products, and provided guidance for LED backlight design, materials and photometry and colorimetry. While there, I developed novel backlight designs and manufacturing processes for both die-on-board and chip-on-board backlights.

10. From 1999 through 2002, I worked as Technical Staff Engineer at Rosen Products LLC, and I was responsible for management of LCD display technology, strategic planning and product benchmarking for automotive and aircraft entertainment systems.

11. After leaving Rosen Products LLC, I established and served as president of FPD Design & Consulting LLC, a display product design and development consulting company specializing in integration of ruggedized display components into customer specified products. I have worked at FPD Design & Consulting LLC from 2002 to the present. Projects I have worked on include direct-view backlight designs for aviation simulators, CCFL to LED backlight conversions, commercial-off-the-shelf LCD display ruggedization and optical enhancement. During this time, I prepared a number of technical papers on display ruggedization, optical enhancement and backlight thermal design, the later as a "how-to" workshop for a local chapter of the Society for Information Display (SID).

12. From 2011 to 2013, I was employed as the Chief Technologist by E3 Displays, LLC. My responsibilities included materials development and qualification (adhesives, EMI shielding, touch panels, LCD backlights & films) as well as supporting sales and design teams in developing technical solutions for display system's optical, mechanical, electrical, and lighting components, including enhanced LED backlight systems and night-vision compatible backlight designs. Key projects at E3 Displays include the development of an etched-nickel micro-mesh for EMI shielding of display screens, the optical design of light guides for high luminance backlights, and the complete re-packaging of a 19-inch mono-chrome LCD panel to meet military ground-vehicle mechanical, thermal, and optical requirements.

13. From 2013 to September 2018, I worked at Riverwood Solutions, Inc. ("RWS") as the Sr. Technical Specialist. RWS provides electronic manufacturing services management for leading product development companies worldwide. As the Sr. Technical Specialist, I provided technical expertise on technology, materials, design, and manufacturability for product applications including medical products, solar powered devices, LED lamps, and LED illumination in electronic consumer products.

14. I received the Honeywell Technical Achievement Award in 1997. The

award recognized my outstanding technical contribution in the field of flat panel display backlighting.

15. I have served on professional committees, groups, and organizations. Between 2001 and 2004, I was a member of the conference organizing committee of Society for Information Display ("SID"). My responsibilities focused on planning annual display symposia including technical paper review and selection and session chair.

16. I am an inventor of U.S. Patent No. 7,660,040, entitled "Diffuse reflective article." I am the author or co-author of 15 scientific and engineering publications, including articles, conference presentations, technical & scientific reports and tutorials. These publications cover a wide variety of topics, including but not limited to flat panel display backlighting techniques, LED backlights, thermal design principles and analysis, design requirements for automotive entertainment displays, development of a high luminance, high contrast fixed format LCD and other areas.

17. A more detailed description of my educational and professional background is set forth in my curriculum vitae, attached hereto as Ex. 1003 to this Declaration.

C. Materials Considered

18. The analysis that I provide in this Declaration is based on my education and experience in the field of electronic display design and integration, as well as the documents I have considered, including the '595 patent (Ex. 1001) and its prosecution history (Ex. 1030). The '595 patent states on its face that it issued from U.S. Application Ser. No. 12/411,925, which was filed on March 26, 2009 and is a Continuation-in-Part of each of the following applications: (a) No. 12/234/307, filed on September 19, 2008; (b) No. 12/234,360, filed on September 19, 2008; (c) No. 12/237,365, filed on September 24, 2008; and (d) No. 12/235,200, filed on September 22, 2008. The '595 patent also claims priority to ten (10) different provisional applications as part of its priority chain, the earliest of which is Provisional Application No. 61/033,064, filed on March 3, 2008. (*See* Ex. 1001, 1:7-42). For the purposes of this Declaration, I have assumed March 3, 2008 as the effective filing date for the '595 patent. I have cited to the following documents in my analysis below:

Exhibit No.	Description
Ex. 1001	U.S. Patent No. 8,854,595 ("'595 Patent")
Ex. 1003	Curriculum Vitae of Robert Smith-Gillespie
Ex. 1004	U.S. Patent Application Publication No. 2003/0043091 to Takeuchi et al. ("Takeuchi")
Ex. 1005	U.S. Patent No. 7,800,706 to Kim et al. ("Kim")

Exhibit No.	Description
Ex. 1006	U.S. Patent Application Publication No. 2007/0171353 to Hong ("Hong")
Ex. 1007	Japanese Unexamined Patent Application Publication No. H11-68363 to Takahashi ("Takahashi")
Ex. 1008	Certified Translation of Japanese Unexamined Patent Application Publication No. H11-68363 to Takahashi ("Takahashi")
Ex. 1009	Korean Unexamined Patent Application Publication No. 10-2006-0016469 to Na ("Na")
Ex. 1010	Certified Translation of Korean Unexamined Patent Application Publication No. 10-2006-0016469 to Na ("Na")
Ex. 1011	Claim Construction Order (D.I. 153) dated October 3, 2018 in *Manufacturing Resources Int'l, Inc. v. Civiq Smartscapes, LLC, et al.*, Civil Action No. 17-269-RGA (D. Del.)
Ex. 1012	Memorandum Opinion (D.I. 150) dated September 27, 2018 in *Manufacturing Resources Int'l, Inc. v. Civiq Smartscapes, LLC, et al.*, Civil Action No. 17-269-RGA (D. Del.)
Ex. 1013	U.S. Patent No. 6,825,828 to Burke, et al. ("Burke")
Ex. 1014	E. Fred Schubert & Jong Kyu Kim, *Solid-State Light Sources Getting Smart*, 308 *Science* 1274 (2005) ("Schubert")
Ex. 1015	U.S. Patent Application Publication No. 2004/0223299 to Ghosh ("Ghosh")
Ex. 1016	Military Handbook: Reliability Prediction of Electronic Equipment, DEPARTMENT OF DEFENSE, MIL-HDBK-217F (1991) ("MIL-HDBK-217F")
Ex. 1017	Allan Webber, *Calculating Useful Lifetimes of Embedded Processors,* TEXAS INSTRUMENTS INCORPORATED, SPRABX4 (Nov. 2014) ("Webber")
Ex. 1018	LIAN-TUU YEH & RICHARD C. CHU, THERMAL MANAGEMENT OF MICROELECTRONIC EQUIPMENT: HEAT TRANSFER THEORY,

Exhibit No.	Description
	ANALYSIS METHODS, AND DESIGN PRACTICES (Dereje Agonafer ed., 2002) ("Yeh & Chu")
Ex. 1019	ALLAN W. SCOTT, COOLING OF ELECTRONIC EQUIPMENT (John Wiley & Sons, 1974) ("Scott")
Ex. 1020	DAVE S. STEINBERG, COOLING TECHNIQUES FOR ELECTRONIC EQUIPMENT (John Wiley & Sons, 1980) ("Steinberg")
Ex. 1021	U.S. Patent No. 5,748,269 to Harris et al. ("Harris")
Ex. 1022	U.S. Patent Application Publication No. 2002/0122134 to Kalua ("Kalua")
Ex. 1023	Custom Luxeon Design Guide, LUMILEDS FUTURE ELECTRONICS, Application Brief AB12 (Nov. 2004) ("Lumileds AB12")
Ex. 1024	Thermal Design Using: Luxeon Power Light Sources, PHILLIPS LUMILEDS LIGHTING COMPANY, Application Brief AB05 (June 2006) ("Lumileds AB05")
Ex. 1025	U.S. Patent Application Publication No. 2006/0177587 to Ishizuka et al. ("Ishizuka")
Ex. 1026	U.S. Patent Application Publication No. 2006/0092348 to Park ("Park")
Ex. 1027	U.S. Patent No. 6,493,440 to Gromatzky et al. ("Gromatzky")
Ex. 1028	U.S. Patent No. 5,991,153 to Heady et al. ("Heady")
Ex. 1029	U.S. Patent No. 6,428,198 to Saccomanno et al. ("Saccomanno")
Ex. 1030	File History for U.S. Patent Application No. 12/411,925
Ex. 1031	MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY (11th ed. 2007) ("Webster")
Ex. 1032	THE OXFORD ENGLISH DICTIONARY (J. A. Simpson & E. S. C. Weiner eds., 2d ed. 1989) ("Oxford")
Ex. 1033	RANDOM HOUSE WEBSTER'S COLLEGIATE DICTIONARY (2d ed. 2000) ("Random House")

II. LEGAL PRINCIPLES

19. I am not an attorney. For purposes of this declaration, I have been informed by counsel for Samsung about certain aspects of the law that are relevant to my analysis and opinions, as set forth below.

A. Prior Art

20. I understand that the "prior art" to the '595 patent includes patents and "printed publications" in the relevant art that predate the '595 patent's priority date. As I explained previously, I have been instructed to assume for purposes of my analysis that March 3, 2008 is the relevant date for determining what is "prior art." In other words, I should consider as "prior art" anything publicly available prior to March 3, 2008. I further understand that, for purposes of this proceeding in the United States Patent Trial and Appeal Board, only patents and documents that have the legal status of a "printed publication" may be relied on as prior art.

B. Claim Construction

21. I understand that under the legal principles, claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have to a POSITA at the time of the invention, *i.e.*, as of the effective filing date of the patent application. I further understand that the POSITA is deemed to read the claim term not only in the context of the particular claim in which a claim term appears, but in the context of the entire patent, including the specification.

22. I am informed by counsel that the patent specification, under the legal principles, has been described as the single best guide to the meaning of a claim term, and is thus highly relevant to the interpretation of claim terms. I understand for terms that do not have a customary meaning within the art, the specification usually supplies the best context of understanding the meaning of those terms.

23. I am further informed by counsel that other claims of the patent in question, both asserted and unasserted, can be valuable sources of information as to the meaning of a claim term. Because the claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims. Differences among claims can also be a useful guide in understanding the meaning of particular claim terms.

24. I understand that the prosecution history can further inform the meaning of the claim language by demonstrating how the inventors understood the invention and whether the inventors limited the invention in the course of prosecution, making the claim scope narrower than it otherwise would be. Extrinsic evidence, such as my expert testimony, may also be consulted in construing the claim terms.

25. I have been informed by counsel that, in *inter partes* review (IPR) proceedings, a claim of a patent shall be construed using the same claim construction standard that would be used to construe the claim in a civil action filed in a U.S.

district court (which I understand is called the "*Phillips*" claim construction standard), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by a POSITA and the prosecution history pertaining to the patent.

26. I have been instructed by counsel to apply the "*Phillips*" claim construction standard for purposes of interpreting the claims in this proceeding, to the extent they require an explicit construction. The description of the legal principles set forth above thus provides my understanding of the "*Phillips*" standard as provided to me by counsel.

27. I understand that some claims are independent, and that these claims are complete by themselves. Other claims refer to these independent claims and are "dependent" from those independent claims. The dependent claims include all of the limitations of the claims on which they depend.

C. Anticipation

28. I understand that a patent claim is anticipated if a single prior art document describes every element of the claim such that a POSITA could practice the claim without undue experimentation.

29. I understand that anticipation may be by express disclosure in the prior art reference. I also understand that if the prior art reference does not expressly set

forth a particular claim element, the prior art reference may still anticipate a patent claim if that element is "inherent" in its disclosure—that is, if it is necessarily found in the reference. A property is inherent even if a POSITA would not have appreciated that property as of the date of that prior art reference.

D. Obviousness

30. I understand that obviousness is a determination of law based on various underlying determinations of fact. In particular, these underlying factual determinations include: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art at the time the claimed invention was made; (3) the differences between the claimed invention and the prior art; and (4) the extent of any proffered objective indicia of non-obviousness. I understand that the objective indicia which may be considered in such an analysis include commercial success of the patented invention (including evidence of industry recognition or awards), whether the invention fills a long-felt but unsolved need in the field, the failure of others to arrive at the invention, industry acquiescence and recognition, initial skepticism of others in the field, whether the inventors proceeded in a direction contrary to the accepted wisdom of those of ordinary skill in the art, and the taking of licenses under the patent by others, among other factors.

31. To ascertain the scope and content of the prior art, it is necessary to first

examine the field of the inventor's endeavor and the particular problem for which the invention was made. The relevant prior art includes prior art in the field of the invention, and also prior art from other fields that a POSITA would look to when attempting to solve the problem.

32. I understand that a determination of obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention. Instead, it is my understanding that in order to render a patent claim invalid as being obvious from a combination of references, there must be some evidence within the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination in a way that would produce the patented invention.

33. I further understand that in an obviousness analysis, neither the motivation nor the purpose of the patentee dictates. Rather, any problem known in the field can provide a reason for combining the prior art in the manner claimed.

III. LEVEL OF ORDINARY SKILL IN THE ART

34. I understand that an assessment of claims of the '595 patent should be undertaken from the perspective of a POSITA as of the earliest claimed priority date, which, as I explained above, I assumed to be March 3, 2008.

35. I understand that a POSITA is a hypothetical person who is presumed

to be aware of all pertinent art, applies conventional wisdom in the art, and is a person of ordinary creativity. I have also been advised that to determine the appropriate level of a POSITA, the following factors may be considered: (1) the types of problems encountered by those working in the field and prior art solutions thereto; (2) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (3) the educational level of active workers in the field; and (4) the educational level of the inventor.

36. Applying these factors, as to the '595 patent, a POSITA in March 2008 would have had a bachelor's degree in a pertinent discipline, such as mechanical engineering, physics, product design, or a related field. Such a person would also have 2–4 years of experience in working with electronic displays and have an understanding of product design issues and failure modes associated with electronic displays. Alternatively, a POSITA would have had 5–7 years of experience in the field working with electronic displays and have a similar understanding of product design issues and failure modes associated with electronic displays. To the extent necessary, a POSITA would have been able to collaborate with one or more other persons of skill in another art (e.g., one of skill in the art of electrical engineering) for one or more aspects with which the other person may have expertise, experience, and/or knowledge that was obtained through her own education, industrial or

academic experience. My opinion regarding the qualifications of a POSITA is based on my knowledge, skill, training, experience and review of the materials discussed herein.

37. Based on this definition, I am a person of ordinary skill in the art at least due to my extensive experience in the areas electronic displays including LCD module design, integration, and ruggedization, cold cathode fluorescent lamp ("CCFL") and light emitting diode ("LED") backlight design and thermal management, and materials development. I was also a person of ordinary skill in the art in the 2007–2008 timeframe relevant to this proceeding.

IV. KNOWLEDGE IN THE ART AT THE TIME OF THE ALLEGED INVENTION OF THE '595 PATENT

38. I understand that a POSITA is presumed to know and be familiar with all of the relevant art in the field at the time of the relevant invention.

39. The technology at issue in the challenged claims of the '595 patent relates to the cooling of electronic displays, including LCD displays with LED backlights. Such displays and their cooling systems have been known and used well-before March 2008.

40. Electronic displays are devices that visually present static or moving images. Electronic displays have been around since the early 1900s and were widely commercialized in the 1940s with the first monochrome television set.

41. A typical LCD display is comprised of three main components: an LCD panel, an electronic driver circuit, and a backlight. The LCD display panel comprises a thin layer of liquid crystal ("LC") material constrained between two sheets of glass, one of which includes a thin film transistor ("TFT") array and the other which includes a color filter ("CF") array. The glass/LC/TFT/CF stack is covered front and rear with a pair of linear polarizers. Electronic control circuits are attached to the LCD panel via flexible printed circuits and connect to row and column lines on the TFT substrate glass. A lighting assembly (backlight unit or "BLU") is housed behind the LCD panel to provide a uniform source of light to the rear of the panel. The light from the BLU is modulated pixel-by-pixel in the LCD panel to provide a color image to the viewer.

42. By 2008, LED backlights had become the backlight of choice in LCD displays based on their longer service, better low temperature performance, increased ruggedness and packaging-friendly formats when compared to CCFL backlights. Eventually, LEDs would provide better color reproducibility and lower power dissipation than CCFLs, furthering their advantages and solidifying the dominance as the light source of choice.

43. In the early- to mid-2000s, as LCD panel size grew, their use in a variety of indoor and outdoor environments outside the home also grew. (*See, e.g.*, Exs.

1013, 1:15-30; 1014, 1274-78.) For example, LCDs began to be used in indoor environments such as commercial offices, in airplanes, airports and train stations, and for advertising displays such as in malls, as well as in outdoor applications such as in ATM machines, information kiosks, bus shelters, billboards, and street level advertising.

44. The use of electronic displays in such applications yields a design consideration that was well-known to those skilled in the art in March, 2008: namely thermal stress. Thermal stress is a general term for both short- and long-term performance reduction of electronic components subject to operation at elevated temperature. The phenomena of thermal stress has been well known for at least the last 50 years,[1] with initial research and requirements developed by and for military equipment electronics. Thermal stress may cause premature failure of components. Known wear-out mechanisms are accelerated by high-temperature operation of semiconductors include gate oxide integrity break-down, electro-migration, and

[1] MIL-HDBK-217A was issued in 1965 to address thermal stress failures in monolithic ICs and other components. In 1994, MIL-HDBK-217F (Ex. 1016) was the last revision of the document as new electronics devices and methods of reliability prediction took hold. The U.S. military discontinued maintenance of the document in 1995.

time dependent dielectric break-down.[2] Thermal stress can also cause component performance to drift or decay temporarily (i.e. at elevated temperature). Thermal stress may be induced by: (i) self-heating of components due to high power dissipation; (ii) exposure to elevated ambient temperatures; and (iii) convective, conductive or radiative heating of the immediate environment by other equipment's heat dissipation or by external sources such as solar radiation. The latter of which is a significant factor for displays used in outdoor environments where the sun may impinge directly on the display.

45. Sensitive electronics in display systems include power supply components, microcontrollers, microprocessors, and other semiconductor components, as well as LEDs used in the backlight, whose performance degradation includes reduction of emitted flux and color shift with increased temperature. These performance concerns were well known at the time of the '595 patent filing. Thus, some cooling mechanism must be used to ensure the continued reliability of electronics, and ultimately, to prevent failure. (*See* Ex. 1018, 2 ("[B]ased on a survey by the U.S. Air Force, and indicating that more than 50% of all electronics failures are caused by shortcomings in temperature control.").)

[2] For a background on failure modes and component reliability, *see* Webber (Ex. 1017).

46. As noted above, the need to control the thermal environment of electronic components is an old problem. Heat generated by the electronics must be efficiently and effectively removed from the components. This process is generally called "cooling." (Exs. 1019, 1 ("All electronic equipment needs cooling."); 1020, 1.) Cooling is accomplished by heat transfer, the movement of thermal energy from one body to another. The three primary modes of heat transfer used to cool electronic equipment are conduction, radiation, and convection. (Ex. 1020, 2.)

47. Convective heat transfer is accomplished via the flowing of a fluid, either liquids or gases across a surface. In heat transfer from a surface, energy is transferred to the fluid by conduction across a boundary layer of air at the surface. This energy is carried away by the now warmed bulk fluid. (Ex. 1020, 3.) In "forced convection," the movement of the air is induced by a mechanical object, such as a fan. (*Id.*) Often, and as is the case in the '595 patent, air acts as the heat transfer fluid.

48. A plenum is a cavity through which a fluid, normally air, flows. The ductwork in a typical heating and air-conditioning system is an example of a plenum system which constrains air flows to and from various regions of a building. Here, the air is moved under the influence of a fan. The air intake system on a modern automobile utilizes a plenum formed by a series of connected tubes and housings.

In this case, the air is moved by a combination of negative pressure at the intake manifold, and positive pressure upstream of the incoming air filter. In electronics cooling applications, the walls of the plenum may be formed of a thermally conductive material on at least the side in contact with the heat source. This encourages conductive heat transfer through the plenum wall and into the moving air stream. (*See, e.g.*, Ex. 1021, 5:18–23.)

49. Since electronic displays contain electronics which are impacted by operation at elevated temperature (*see, e.g.,* any of the Temperature Factor tables in MIL-HDBK-217 (Ex. 1016), an example of which is shown below), the thermal design of displays is always a key consideration. Cooling designs incorporating convection have been incorporated in displays for decades. The following examples are offered to highlight the state of the art several years prior to the ’595 filing wherein thermal considerations and countermeasures were taken by the inventors.

6.3 TRANSISTORS, LOW FREQUENCY, BIPOLAR

$\lambda_p = \lambda_b \pi_T \pi_A \pi_R \pi_S \pi_Q \pi_E$ Failures/10^6 Hours

Base Failure Rate - λ_b

Type	λ_b
NPN and PNP	.00074

Temperature Factor - π_T

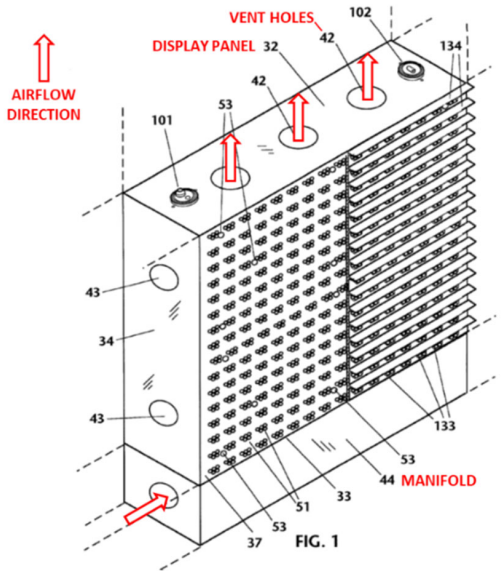
T_J (°C)	π_T	T_J (°C)	π_T
25	1.0	105	4.5
30	1.1	110	4.8
35	1.3	115	5.2
40	1.4	120	5.6
45	1.6	125	5.9
50	1.7	130	6.3
55	1.9	135	6.8
60	2.1	140	7.2
65	2.3	145	7.7
70	2.5	150	8.1
75	2.8	155	8.6
80	3.0	160	9.1
85	3.3	165	9.7
90	3.6	170	10
95	3.9	175	11
100	4.2		

$$\pi_T = \exp\left(-2114\left(\frac{1}{T_J + 273} - \frac{1}{298}\right)\right)$$

T_J = Junction Temperature (°C)

(Ex. 1016, § 6.3.)

50. Kalua (Ex. 1022) addresses issues in direct-view LED displays related to thermal impact on LED lifetimes and the need for cooling systems. It further includes at least one embodiment of a forced air-cooling system in which the display housing acts as cascaded plenum units for constricting air flow in the LED panel units to cool the displays, as reflected by Figure 1 (annotated):



(Ex. 1022, FIG. 1 (annotated).) Kalua explains:

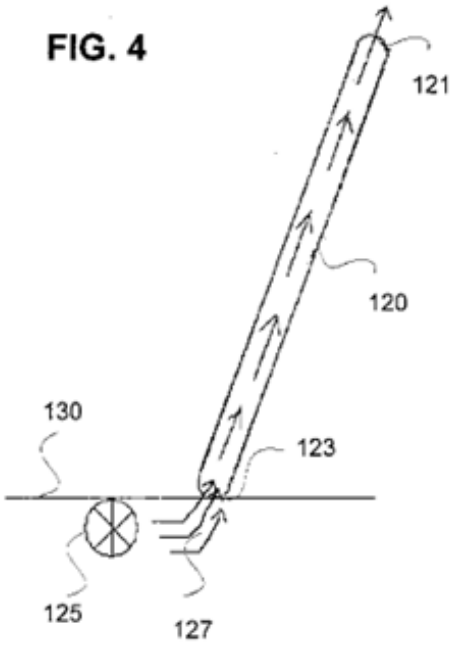
> Although LEDs have an extremely long mean time before failure (MTBF), they must be protected from damage due to particular operating conditions. For example, ***when LEDs overheat the life expectancy quickly may be shortened by factors of 10***. Heat buildup may be caused not only by the waste heat of the LEDs operating at high power, but also by external factors such as hot ambient air due to hot weather, high heat loads from direct sunlight, and the like. ***Generally speaking, some form of cooling system must be available to rid the LED systems of heat buildup to avoid diminishing the life of the LEDs***."

(*Id.*, ¶[0003] (emphasis added).) Kalua further explains:

> The image units are arrayed in columns and rows, and ***the bottom row is supported on a manifold that supplies cold air or other coolant through spaced holes in the manifold. the top and bottom panels*** of ***each image unit includes at least one vent hole to promote the flow of coolant upwardly*** through the columns of image units. ***An exhaust manifold is secured to the top of the uppermost row of the array to carry away the coolant***, whereby substantial heat is removed from the video array.

(*Id.*, ¶[0013] (emphasis added).)

51. In an LCD panel related example, Figure 4 from Ghosh (Ex. 1015) illustrates a simple "forced convection" method for cooling a flat screen display in a laptop computer:



(Ex. 1015, FIG. 4.)

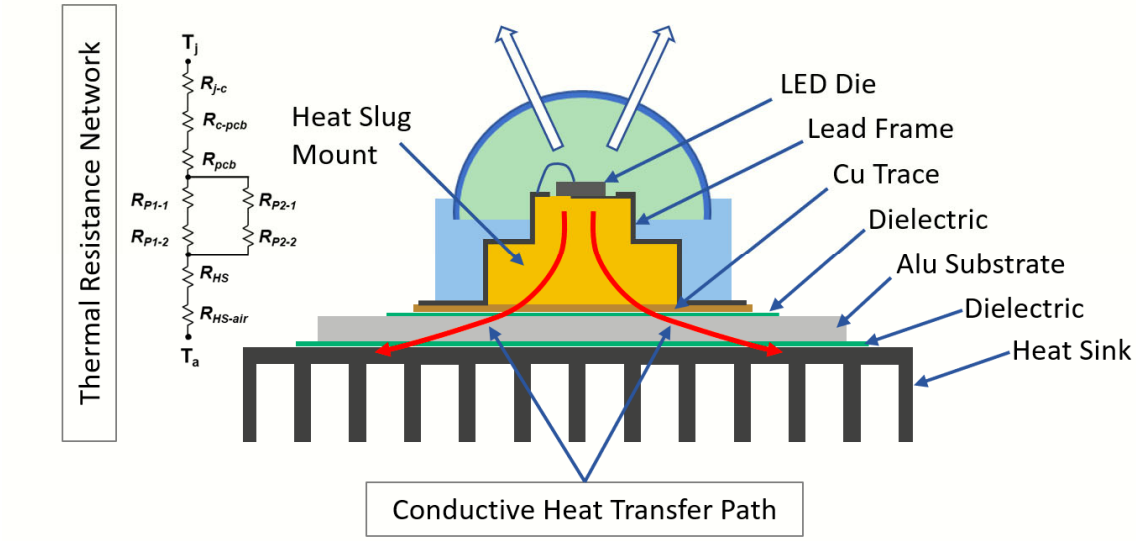
52. In this figure, display unit **120** comprises a display screen and other electronic components such as circuits, chips, batteries, etc. (Ex. 1015, ¶[0020].) These electronic components generate heat, and must be cooled to operate properly. Air can enter and exit through apertures **123** and **121**, respectively. (*Id.*) When operating, the air movement device **125**, such as a fan, moves cool air through aperture **123** and pushes it upwards through a cavity. (*Id.*, ¶¶[0021]-[0022].) As the air passes through display unit **120**, heat is transferred via convection from the electronic components of the display to the air stream, thereby cooling the display. (*Id.*) The heated air then exits through aperture **121**. (*Id.*, ¶[0022].)

53. Prior to the use of LEDs as LCDs backlight light sources, LCD

backlights depended predominantly on CCFL light sources. CCFL lamps comprise phosphor coated, tubular glass envelopes with electrodes placed at both ends. CCFLs emit light from the entire envelope but are limited in their luminous efficiency to around 65-70 lumens/watt, require very high voltages (typically >500V for a 300mm long lamp) and contain mercury, raising environmental concerns. As phosphor converted white LEDs started to reach roughly 50 lumen/watt efficiencies in the mid-2000s, their use in LCD backlights gained in popularity for several reasons. LEDs did not contain mercury, were driven at low voltages, did not suffer from cold-temperature operation (a big issue with CCFLs), and could withstand mechanical stress better than CCFLs. LEDs also promised the possibility of thinner LCD module packages with higher LCD color gamuts, and eventually higher luminous efficiencies than CCFL based products. However, LEDs are point sources and, as such, the heat generated in the LED package must be efficiently removed to prevent reduction in luminous efficiency and lifetime reduction.

54. LEDs dissipate electrical power as light, radiated heat (IR radiation), and conducted heat. The dominant pathway for heat dissipation in LEDs is via conduction from the LED die through both the lead frame and heat slug mount (if used) to the LED printed circuit board (PCB). The PCB should facilitate conduction to a heat sink while additionally spreading the heat over a large area to reduce the

junction temperature of the LED die. PCBs can be made of epoxy-fiberglass composite, such as FR-4, with single or multiple copper conductor layers, or using a metal core substrate with a single stack of circuit conductor and dielectric film.



55. Metal core printed circuit boards (MCPCBs) are a special class of PCBs whose unique properties of high thermal conductivity both in-plane and cross-plane makes them attractive for medium- to high-power dissipation applications. Compared to typical composite circuit boards, an aluminum core circuit board can have several-times higher the thermal conductivity of that of an FR-4 (fiberglass-epoxy) circuit board (~3.0W/m-K vs. 0.3W/m-K, respectively). The higher thermal conductivity will allow roughly several-times higher power dissipation in a component for the same rise in device junction, all other things being equal.

56. The use of MCPCBs dates to the 1970s for use in power electronics applications. (Ex. 1020, § 3.6, Fig. 3.5.) While FR-4 has been the de facto standard for medium- to low-power applications in standard environments (office, factory, home, etc.), as LEDs increased in power to hundreds of milliwatts and eventually more than a watt per package, more efficient thermal designs called for the use of metal core boards. For example, Lumileds AB12 instructed use of their 1-Watt LED products with MCPCBs stating "Luxeon Power Light Sources do require additional heat sinking to the aluminum-core PCB." (Ex. 1023, 11; *See also* Ex. 1024, 2 (noting all Level 2 Luxeon products are mounted on a MCPCB, which acts as a thermal heat sink interface).)[3]

V. THE '595 PATENT

A. Overview of the '595 Patent

57. The '595 patent, which is titled "Constricted convection cooling system for an electronic display," issued from U.S. Application Ser. No. 12/411,925 filed on March 26, 2009. (Ex. 1001, face page.)

[3] Both of these Lumileds Design Guides (Exs. 1023 and 1024) are documents that I was familiar with as of the priority date of the '595 patent and both are documents of the type that a POSITA would rely upon in designing LED devices, and packaging and thermal protection solutions for LED devices.

58. The ’595 patent relates to cooling of electronic displays, including LCD displays using a “constricted convection channel [] to force cooling air against” claimed surfaces of and in the electronic display. (*Id.*, Abstract, 4:20-23.). The specification of the ’595 patent identifies a few types of flat display systems, including “LCD (including TFT or STN type), light emitting diode (LED), organic light emitting diode (OLED), field emitting display (FED), cathode ray tube (CRT), and plasma displays.” (*Id.*, 4:20-23.)

59. The specification discloses that “[c]onductive and convective heat transfer systems for electronic displays are known,” including systems that “have relied primarily on fans for moving air past the components to be cooled and out of the display.” (*Id.*, 1:52-58.)

60. Figure 5B is an exemplary embodiment of the alleged invention set forth in the challenged claims and includes display (**10**) and fan (**52**) which “draw[s] ambient air between the posterior display surface (**22**) and the constricted convection plate (**30**).”

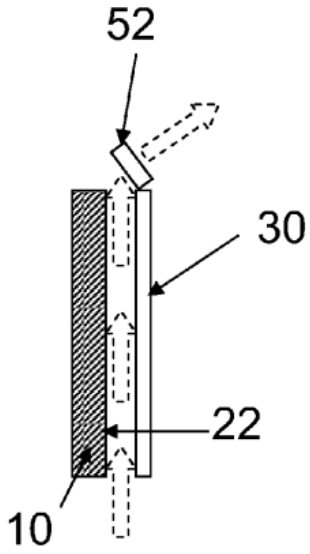
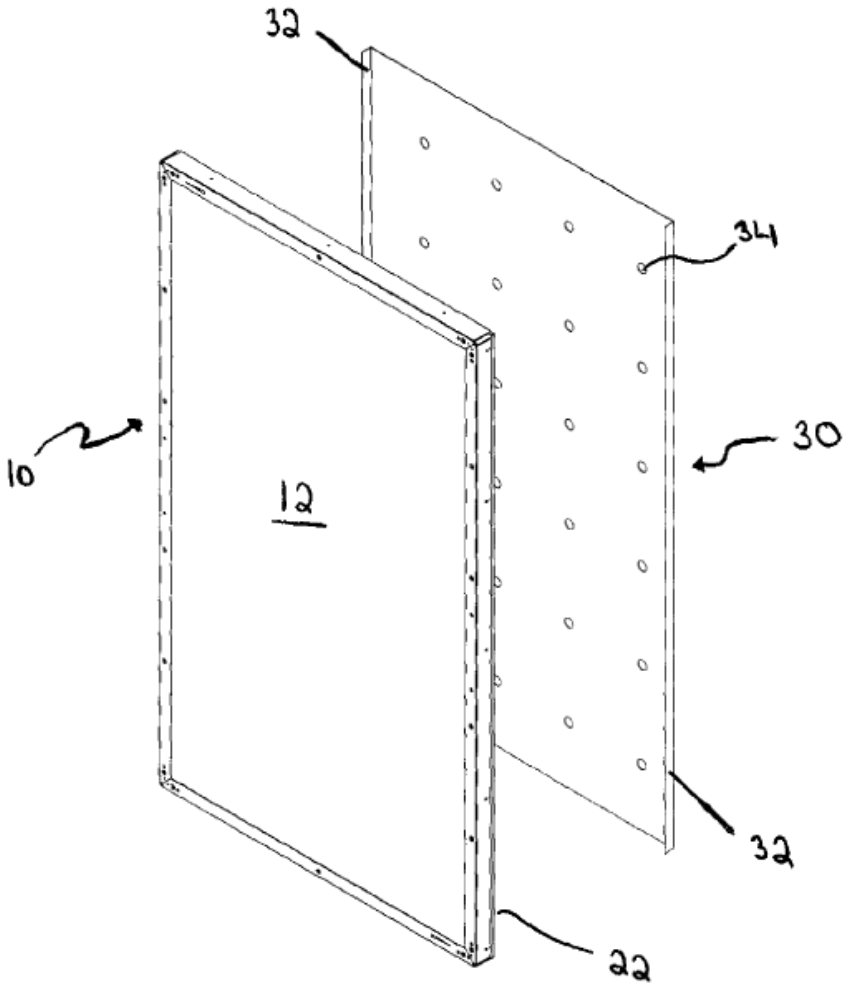


Fig. 5B

(*Id.*, 6:1-5.)

61. In challenged claim 1, the constricted convection plate includes side panels. According to the specification, "side panels **32** are adapted to extend from the constricted convection plate **30** and make contact with the display posterior **22** and direct air through the constricted convection channel **50**." (*Id.*, 5:1-4.) The constricted convection plate **30** may also include access apertures **34** that "allow access to hardware found on the display posterior **22**." (*Id.*, 5:5-8.) Figure 4 is an exemplary embodiment showing side panels **32** and access apertures **34**:



(*Id.*, Fig. 4.)

62. The patent acknowledges that an LCD display has a backlight assembly which may be made of "a printed circuit board (PCB) with a plurality of LEDs mounted" to the front surface of the PCB. (*Id.*, 4:52-55.) Heat generated by LEDs and other electronic components must be dispersed to prevent overheating and malfunction. (*Id.*, 3:5-8.) For example, the PCB may be made of metal, so that heat

emitted by the LEDs can easily pass from the front side of the PCB to the rear, or posterior side of the LEDs. (*Id*., 4:55-65.)

63. According to the ’595 patent, it is necessary to uniformly cooling a display with an LED backlight as “individual LEDs may fail prematurely if exposed to high levels of heat for an extended period of time.” (*Id*., 3:5-8.) The patent acknowledges “conductive and convective heat transfer systems for electronic displays [were] known,” including systems that “have relied primarily on fans for moving air past the components to be cooled and out of the display.” (*Id.*, 1:52-58.) The patent states that while “systems of the past have attempted to remove heat from the entire interior of the display, a preferred embodiment causes directed convective heat transfer from the anterior of the display.” (*Id*., 2:30-45.)

64. The ’595 patent discusses a few other features, some optional, that can be used along with the “constricted convection channel” such as an exterior housing. (*Id.*, 2:45–46.)

B. Prosecution History

65. I reviewed the history of the application as it was considered and then approved by the patent office, which I understand is called the “prosecution history.” (Ex. 1030.) I am aware the Patent and Trademark Office entered several office actions rejecting the claims based on a number of prior art references, relying

primarily on: (a) Ishizuka (Ex. 1025); (b) Park (Ex. 1026); (c) Saccomano (Ex. 1029); (d) Gromatzky (Ex. 1027); and (e) Heady (Ex. 1028).

66. The Patent Owner made several amendments to overcome the rejections based on this prior art and the claims were allowed in a Notice of Allowance dated August 21, 2014. (Ex. 1030, 369.) The '595 patent issued on October 7, 2014. (*Id.*, 398.)

67. None of the references cited herein were considered by the examiner during prosecution of the '595 patent, nor are they cumulative of the references the examiner did consider.

C. The Challenged Claims

68. This Declaration addresses claims 1, 4, 7, and 8 of the '595 patent. Claims 1 and 4 are the independent claims. Some of the terms in the claims have previously been construed in a different litigation by the United States District Court for the District of Delaware, as explained *infra.*

69. Independent Claim 1 recites:

1[pre]	A system for cooling an electronic display having a posterior display surface and contained within a housing, the system comprising:
1[a]	a constricted convection plate placed posterior to the posterior display surface;

1[b]	two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit; and
1[c]	a fan placed to draw air from outside of the housing through the constricted convection channel.

70. Independent Claim 4, with terms previously construed by the Delaware District Court, recites:

4[pre]	A liquid crystal display (LCD) comprising:
4[a]	a liquid crystal stack;
4[b]	a backlight assembly behind the liquid crystal stack and comprising: a metal core printed circuit board (PCB) having front and back sides; a plurality of LEDs mounted on the front side of the PCB; a posterior surface on the rear side of the PCB;
4[c]	a constricted convection plate placed behind the posterior surface of the PCB, defining a constricted convection channel having an entrance and an exit; and
4[d]	a fan positioned to draw air through the constricted convection channel.

71. Dependent Claim 7 recites:

7	The LCD from claim 4 wherein:
	the fan is placed near the exit of the constricted convection channel.

72. Dependent Claim 8 recites:

8	The LCD from claim 4 further comprising:
	a plurality of access apertures through the constricted convection plate.

73. I have added indices of the form 1[pre], [a], 1[b], *etc.* to each of the claim elements of the independent claims for ease of reference, and to match the indices used in the Petition.

D. Claim Construction

74. I understand that Patent Owner previously asserted the ’595 patent against other third parties, including Civiq Smartscapes LLC, in patent litigation in the United States District Court for the District of Delaware, captioned *Manufacturing Resources, Inc. v. Civiq Smartscapes, LLC*, No. 1:17-cv-00269 (D. Del.). I further understand that in that litigation, the District Court on October 3, 2018 issued a Claim Construction Order (Ex. 1011) and on September 27, 2018 issued a Memorandum Opinion (Ex. 1012) where it construed two terms used in the

challenged claims of the ’595, which I discuss herein.

75. In particular, I understand that the Delaware District Court construed the term “**posterior display surface**” as used in claim 1 of the ’595 patent to mean **“rear-facing surface of the display assembly**.” (Exs. 1011, 1; 1012, 6-8.) I understand that the Court reasoned that a “backlight assembly” and “thin panel display assembly” are “examples of a ‘display assembly,’” and that the patent’s disclosures at 2:51-54 and 3:5 supported its construction. (Ex. 1012, 7-8.) For the purposes of this Declaration, I have applied that construction in my analysis of the validity of claims 1, 4, 7 and 8 of the ’595 patent for the reasons provided by the District Court.

76. I further understand that the Delaware District Court construed the term “**constricted convection channel**” as used in challenged claims 1, 4, and 7 to mean “**constricted channel through which air may flow to remove heat from the posterior display surface**.” (Exs. 1011, 1-2; 1012, 10-11.) For the purposes of this Declaration, I have applied that construction in my analysis of the validity of claims 1, 4, 7, and 8 of the ’595 patent for the reasons given by the District Court.

77. I believe that the term “**a fan positioned[/placed] to draw air [from outside of the housing] through the constricted convection channel**” as used in claims 1 and 4 also requires construction for purposes of these proceedings. It is my

opinion that this term should be construed to mean "**a fan positioned to pull air [from outside the housing] through and out of the constricted convection channel**." Such an interpretation is consistent with usage of the term "draw" in the specification. For example, the specification explains that the claimed cooling system may include fans **52**, which "pull the air through the constricted convection channel **50**." (Ex. 1001, 5:45-58.) The specification further makes clear that the fans "draw ambient air" (i.e., air from outside the housing) through the constricted convection channel. (*Id.*, 5:65-67; 6:1-5; Figs. 5B & 5D.) This construction is also consistent with the plain and ordinary meaning of "draw" as set forth in general purpose dictionary usage. (*See, e.g.*, Exs. 1031, 379 ("to pull up or out of a receptacle or place where seated or carried"); 1032, 1023 ("To cause (anything) to move toward oneself by the application of force; to pull"); 1033, 3 ("to cause to move in a particular direction by or as if by a pulling force; pull; drag").)

78. Otherwise, in my analysis of the validity of claims 1, 4, 7 and 8 of the '595 patent, I have applied my understanding of what would be the plain and ordinary meaning to a POSITA of all other claim terms appearing in those claims.

VI. APPLICATION OF THE PRIOR ART TO ASSERTED CLAIMS

79. I have reviewed and analyzed the prior art references and materials listed in Part I.A. above. In my opinion, the claims of the '595 patent are rendered

unpatentable based on the following prior art:

Ground	References	Claim(s)
1	Takeuchi [Ex. 1004]	1
2	Kim [Ex. 1005]	1
3	Kim [Ex. 1005] in view Hong [Ex. 1006]	4, 7
4	Kim [Ex. 1005] in view of Hong [Ex. 1006] and further in view of Takahashi [Ex. 1008]	8
5	Na [Ex. 1010] in view of Kim [Ex. 1005]	1
6	Na [Ex. 1010] in view of Hong [Ex. 1006]	4, 7, 8

80. I am informed by counsel that each reference listed above qualifies as prior art to the challenged claims because each reference was filed and/or published before the earliest claimed priority date of March 3, 2008 for the '595 patent. I reserve the right to respond in the future to any arguments or positions that the Patent Owner may raise, taking account of new information as it becomes available to me.

A. Brief Summary of Prior Art

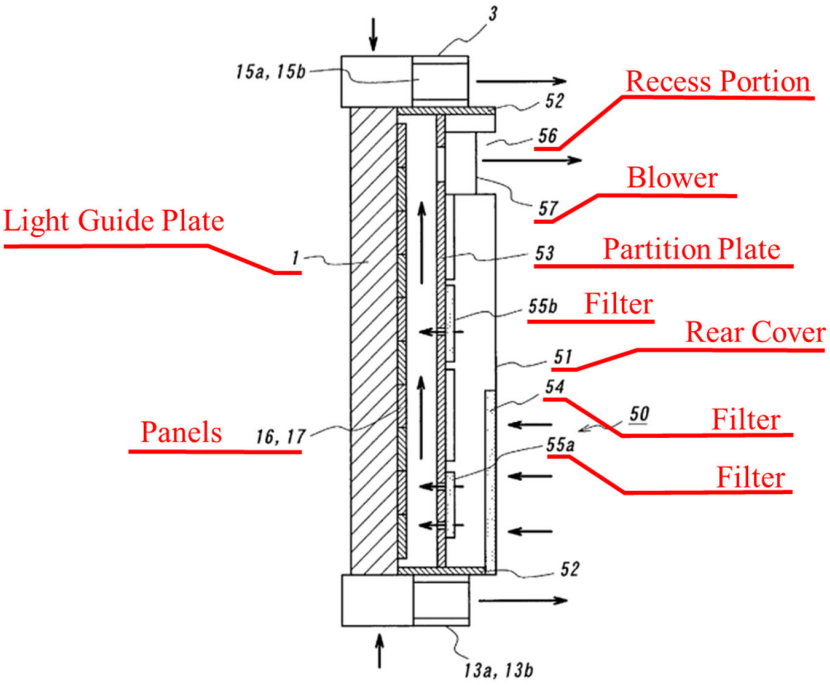
1. Takeuchi [Ex. 1004]

81. U.S. Patent Publication No. 2003/0043091 ("Takeuchi") (Ex. 1004),

entitled "Display System with Cooling Device," published on March 6, 2003 from Application No. 10/234,730, filed on September 4, 2002, which claims foreign priority to Japanese Application No. 2001-269997, filed on September 6, 2001. I am informed that Takeuchi qualifies as prior art to the '595 patent pursuant to at least pre-AIA 35 U.S.C. § 102(b) because it was published more than one year before the earliest claimed priority date for the '595 patent.

82. Takeuchi describes a display system that includes a cooling device for properly cooling the display system, a light guide plate for transmitting light through the display system, and a panel portion arranged opposite to a back of the light guide plate. (Ex. 1004, Abstract, ¶¶[0007], [0009].) The panel portion causes a video image to be displayed on the light guide plate according to an inputted image signal. (*Id*.)

83. Takeuchi's cooling device for its display system cools the light guide plate from its backside, as illustrated in Figure 5:



(*Id.*, FIG. 5; *see also id.*, Abstract, ¶¶[0007], [0009].) In the cooling system **50**, "the back sides of the light guide plate **1** and the panels **16**, **17** are completely covered by a rear cover **51**," which includes inner surface portions **52** of rear cover **51**. (*Id.*, ¶[0040].) As further shown in Figure 5, a partition plate **53** is positioned between the rear cover **51** and the back sides of the light guide plate **1** and the panels **16**, **17**. (*Id.*) Takeuchi discloses that the partition plate **53** "form[s] a flow path of the fluid in contact with the back of the light guide plate," (*id.*, ¶[0011]), and "defines a cooling chamber on the back sides of the light guide plate **1** and the panels **16**, **17**." (*Id.*, ¶[0040].)

84. As also shown in Figure 5, Takeuchi discloses "[a]n intake vent

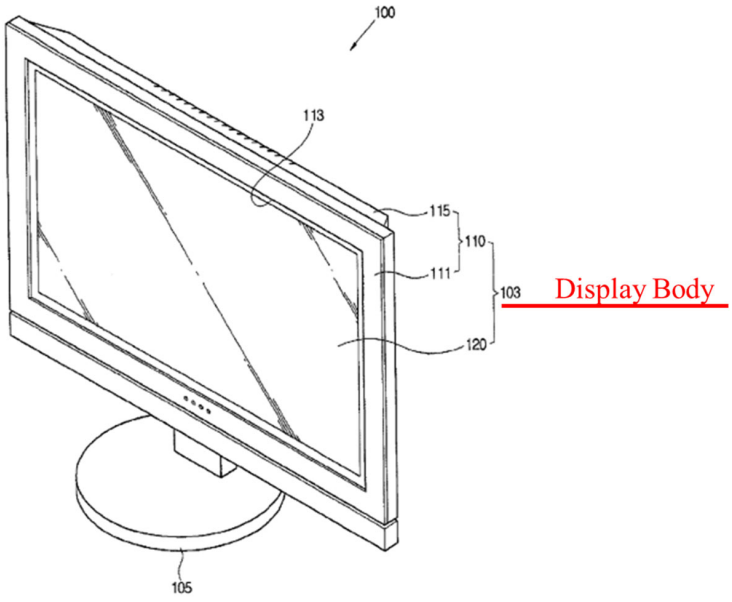
provided with a coarse filter **54** [] arranged in the lower portion of the rear cover **51**." (*Id.*) Takeuchi discloses that an exhaust vent and a blower **57**, which may be a sirocco fan, are provided in the upper portion of the partition plate **53** at a position corresponding to the recess portion **56**. (*Id*., ¶¶[0011], [0040].) The blower **57** "introduce[s] ambient air into the cooling chamber defined by the partition plate **53** through the filters **54**, **55*a***, **55*b***, while removing foreign matters in the ambient air, such as dust." (*Id*., ¶[0041].) Takeuchi teaches that the "ambient air introduced into the cooling chamber flows from the lower side toward the upper side of the chamber, cooling the light guide plate **1** and the panels **16, 17** from the back sides, and is sucked from the exhaust vent in the upper portion of the partition plate **53** into the blower **57**, and then exhausted from the recess portion **56** of the rear cover **51** to outside." (*Id*.)

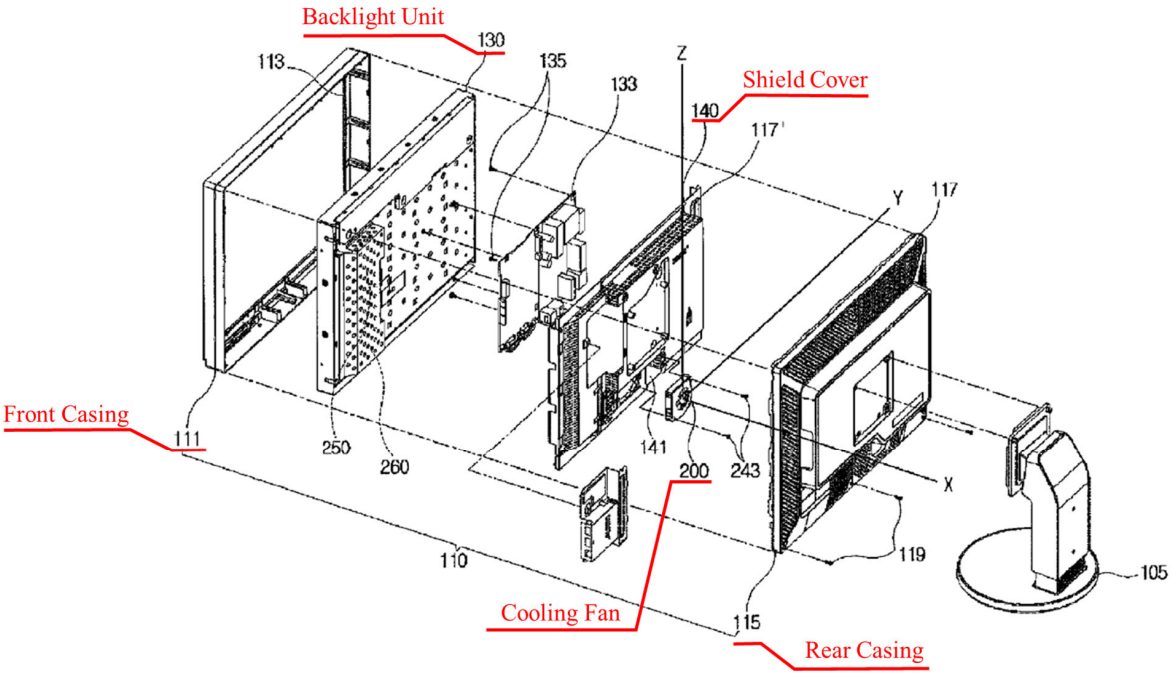
2. Kim [Ex. 1005]

85. U.S. Patent No. 7,800,706 ("Kim") (Ex. 1005), entitled "Cooling Fan Unit and Display Apparatus Having the Same," issued on September 21, 2010 from Application No. 11/778,138, filed on July 16, 2007, which claims foreign priority to Korean Application No. 10-2006-0100537, filed on October 16, 2006. I am informed that Kim qualifies as prior art to the '595 patent pursuant to at least pre-AIA 35 U.S.C. § 102(e)(2) because it was described in a patent granted on an

application for a patent by another filed in the United States before the invention of the '595 patent.

86. Kim is directed to "a cooling fan unit with improved cooling efficiency by efficiently cooling heat generated from a backlight unit, and a display apparatus having the same." (Ex. 1005, 1:46-49.) As reflected by Figures 1 and 2, Kim's display apparatus **100** "generally comprises a display body **103** and a stand **105** that supports the display body **103**." (*Id.*, 4:1-4.) The display apparatus further comprises "a casing **110**" with "a front casing **111** and a rear casing **115**" that accommodates and supports an LCD panel **120**, a backlight unit **130**, a shield cover **140**, and a cooling fan **200**:





(*Id.*, 4:1-12; FIGs. 1 & 2.) "The front casing **111** comprises an opening part **113** and supports the liquid crystal display panel **120** on which an image is displayed." (*Id.*, 4:13-15.)

87. Kim discloses that "[t]he backlight unit **130** comprises a plurality of light emitting diodes (LEDs) as a light source **131** (see FIG. 5) that generates light." (*Id.*, 4:33-35.) As shown in Figure 2, a "circuit board **133** that applies or controls power to the light source **131** . . . is combined to the rear side of the backlight unit **130** and is connected to the controller **260**." (*Id.*, 4:38-41, FIG. 2.) Kim discloses that "[t]he circuit board **133** may be combined to a casing (not shown) of the backlight unit **130**" via screws **135**. (*Id.*, 4:41-43.) The light

source **131** "generates heat of high temperature when the light source **131** emits light." (*Id.*, 4:43-46.) "The shield cover **140**, which is provided in the rear side of the backlight unit **130**, is supported by at least one of the backlight unit **130** and the casing **110**, with a space formed between the shield cover **140** and the backlight unit **130**." (*Id.*, 4:52-55.) "The shield cover **140** may have a plurality of air slits **117′** through which flowing air produced by the cooling fan **210** comes in and out," and it "may be formed in diverse shapes such that the flowing air produced by the cooling fan **210** can be efficiently guided." (*Id.*, 4:59-63.)

88. To address the heat generation within the display apparatus, a "cooling fan unit **200** is combined to the shield cover **140** to cool the heat generating parts such as the light source **131** and the circuit board **133** of the backlight unit **130**." (*Id.*, 5:16-18.) As shown in Figure 5, the cooling fan **210** may be disposed adjacent to the heat generating parts to improve the cooling effect:

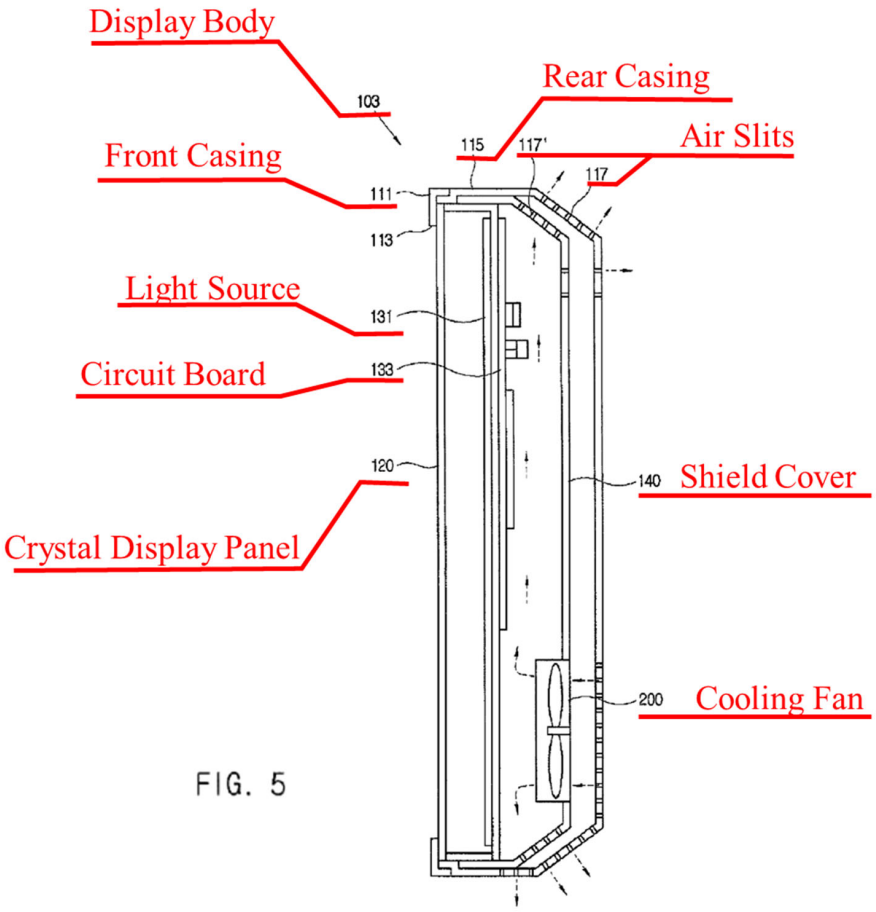


FIG. 5

(*Id.*, 5:26-28; FIG. 5.)

89. Likewise, the cooling fan unit **200** may be placed in a lower central portion of the shield cover **140**, or it may be placed in a central portion or an upper portion of the shield cover **140**, if necessary. (*Id.*, 5:38-42.) The cooling air generated by the cooling fan **210** cools the light source **131** (which is widely distributed on the plane of the backlight unit **130)** and the circuit board **133**, by the cooling air flowing through the "space between the shield cover **140** and the

backlight unit **130**." (*Id.*, 5:34-38; *see also id.*, 4:52-55.) The cooling fan **210** "may draw in the cooling air from the outside into the heat generating parts or discharge the cooling air to the outside through the heat generating parts depending on its rotation direction." (*Id.*, 5:42-45.)

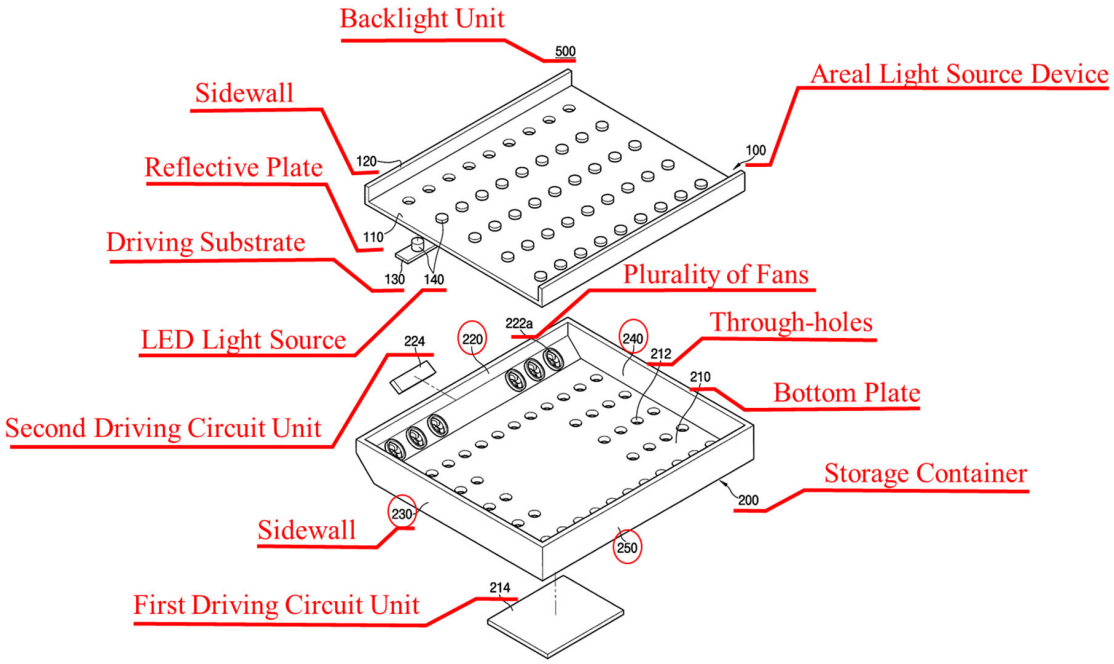
3. Na [Exs. 1009-1010][4]

90. Korean Patent Publication No. 10-2006-0016469 ("Na") (Exs. 1009-1010), titled "Backlight Unit and Liquid Crystal Device Including the Same," published on February 22, 2006 from Korean Patent Application No. 10-2004-0064922, filed August 18, 2004. I am informed that Na qualifies as prior art to the '595 patent pursuant to at least pre-AIA 35 U.S.C. § 102(b) because it was published more than one year before the invention of the '595 patent.

91. Na discloses a "backlight unit and a liquid crystal display [LCD] device including the same," in which the backlight unit "includes a light generator and a storage container." (Ex. 1010, Abstract.) The LCD device "uses the electrical and optical characteristics of liquid crystal to display an image," and "has the advantage of being very small in volume and in weight" so as to be "widely used for portable computers, communication devices, liquid crystal TVs, etc." (*Id.*, 2)

[4] Unless otherwise stated, all citations are to the certified translation of Na (Ex. 1010).

92. The light generator "generates light," while the storage container "accommodates the light generator, and an intake unit through which external air is sucked and an exhaust unit through which internal air is discharged are formed." (*Id.*, Abstract) As shown in Figure 1, a backlight unit **500** includes "an areal light source device **100** and a storage container **200**":



(*Id.*, 4, FIG. 1.) The "areal light source device **100** includes a reflective plate **110**, a sidewall **120**, a driving substrate **130**, and a plurality of light emitting diode [LED] light sources **140**." (*Id.*, 4). The LED light sources **140** "are arranged in a line on the driving substrate **130**, pass through the coupling holes **112** and are coupled to be positioned on the upper surface of the reflective plate **110**." (*Id.*)

93. "The storage container **200** includes a bottom plate **210**, a first sidewall

220, a second sidewall **230**, a third sidewall **240**, and a fourth sidewall **250**." (*Id.*, 4) As separately shown in Figure 13, the "edge portion" of a "color filter substrate **846** is surrounded by the chassis **860**, and a portion of the chassis **860** is coupled to a storage container **200**." (*Id.*, 8.)

94. "The bottom plate **210** has a rectangular flat plate shape and includes a first driving circuit unit **214** and a plurality of through-holes **212**." (*Id.*, 4.) "The through-holes **212** are formed in portions except for the portion where the first driving circuit unit **214** is disposed, and are formed through the bottom plate **210**." (*Id.*) Na discloses that "[a]ir may move through the through-holes **212**," and the through-holes **212** may "function as an intake unit through which external air is sucked." (*Id.*) "A plurality of fans **222a** are formed on the first sidewall **220**." (*Id.*) "The fans **222a** are operated to flow air from the inner space to the outside." (*Id.*) In addition to the embodiments disclosed in Figures 1 – 13, Na points out that it is possible to form through-holes in the side walls: "In the present exemplary embodiment, although the through-holes are formed on the bottom plate, the through-holes may be further formed in the first to fourth sidewalls, ***or may be formed only in the first to fourth sidewalls***." (*Id.*, 5, FIG. 3 (emphasis added).)

4. Hong [Ex. 1006]

95. U.S. Patent Publication No. 2007/0171353A1 ("Hong") (Ex. 1006),

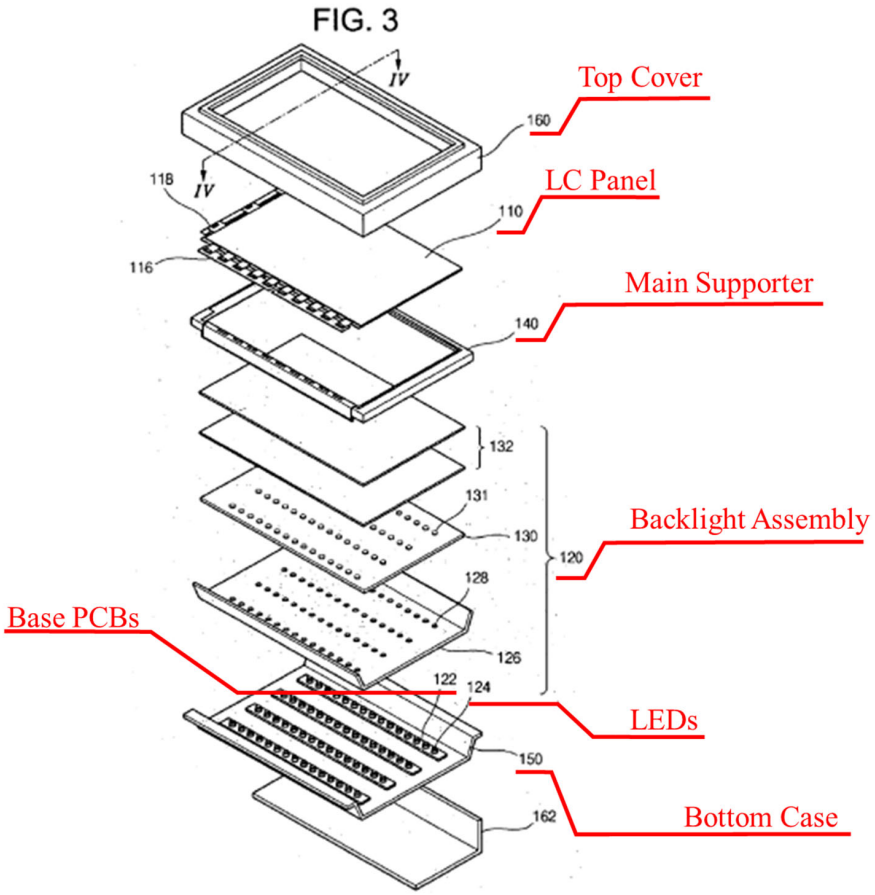
"Liquid Crystal Display Device," published on July 26, 2007, from Application No. 11/638,210, filed on December 13, 2006, which itself claims foreign priority to Korean Application No. 2006-006321, filed on January 21, 2006. I am informed that Hong qualifies as prior art to the '595 patent pursuant to at least pre-AIA 35 U.S.C. § 102(a) and (e)(1).

96. Hong discloses "[a] liquid crystal display [LCD] device includes a backlight assembly with a light source between a liquid crystal panel and a bottom." (Ex. 1006, Abstract.)

97. As reflected in Figure 3, Hong discloses that its LCD device includes "a backlight assembly **120** and a liquid crystal panel **110** [which] may be disposed over an inner surface of a bottom case **150**." (*Id.*, ¶[0025].) Hong further discloses "[a] main supporter **140** has a rectangular frame shape and supports the backlight assembly **120** and the liquid crystal panel **110**." (*Id.*, ¶[0026].) "A top cover 160 is disposed on a front surface of the LCD panel." (*Id.*, ¶[0028].)[5] As shown in annotated Figure 3 below, the backlight assembly **120** includes a base PCB **122**, which "is placed on an inner surface of the bottom case **150**[.]" (*Id.*, [0033].) "The

[5] Hong refers to element **110** as both a "liquid crystal panel" and an LCD panel. (*See, e.g.*, ¶[0028] ("A top cover **160** is disposed on a front surface of the LCD panel. . . . The top cover **160** presses and fixes a peripheral portion of the liquid crystal panel **110** . . . .").) A POSITA would have understood LCD panel and LC panel to refer to the same thing.

peripheral portion of the liquid crystal panel **110** is placed on the main supporter **140**," and "[t]he top cover **160** surrounds the liquid crystal panel **110**." (*Id.*) A POSITA would have understood this to disclose that the backlight assembly **120** is necessarily disposed behind the liquid crystal panel **110**.

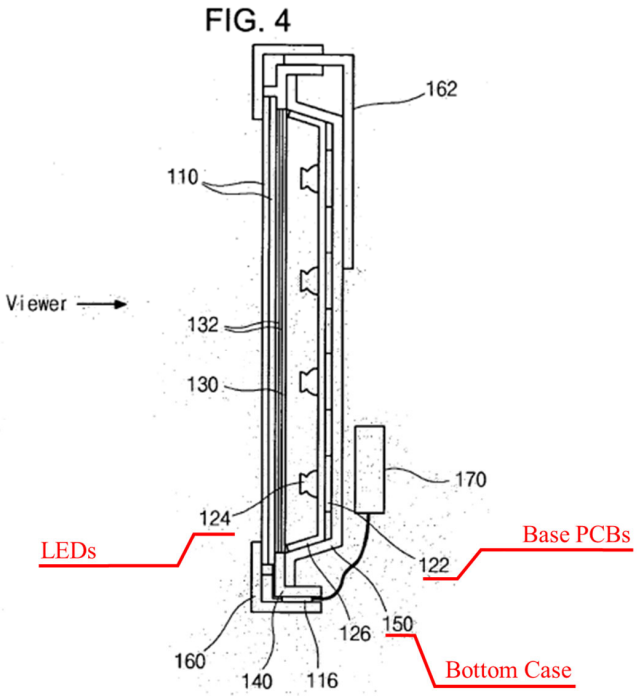


(*Id.*, ¶¶[0029], [0033], FIG. 3 (annotated).) Hong discloses that "[t]he base PCB **122** may include a MCPCB (metal core printed circuit board) which may effective absorb and transfer heat produced at the LED **124**." (*Id.*, ¶[0029].)

98. As shown in Figure 4, "[t]he backlight assembly **120** includes a

plurality of LEDs **124**," which "may be arranged on a plurality of base PCBs **122**."

(*Id.*, ¶[0029.) "The base PCBs **122** are arranged in parallel on the bottom case **150**":



(*Id.*, ¶[0029]; FIG. 4 (annotated).) $

5. Takahashi [Exs. 1007-1008] [6]

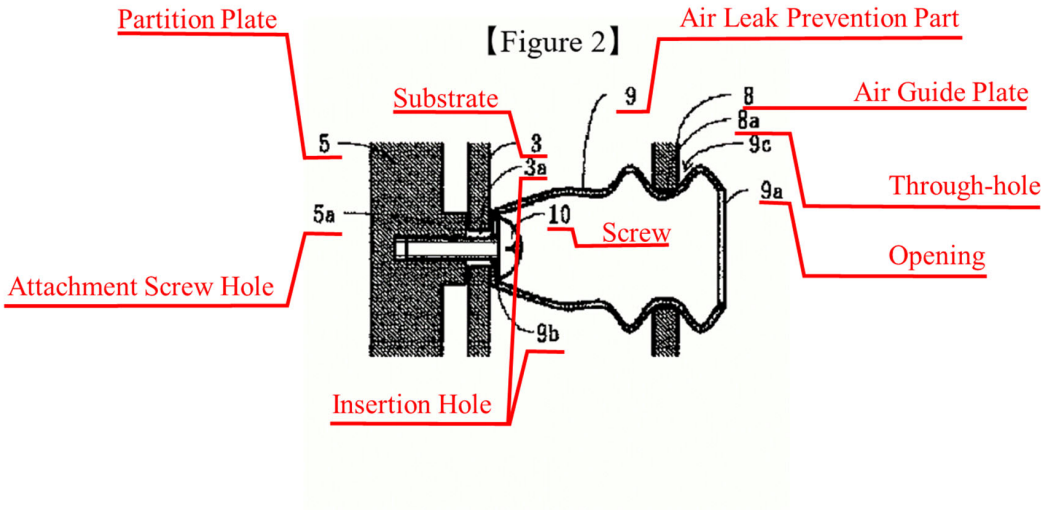
99. Japanese Unexamined Patent Publication No. H11-68363 ("Takahashi") (Exs. 1007-1008), titled "Heat Dissipation Structure for Electronics," published on March 9, 1999 from Japanese Patent Application No. H9-223710, filed August 20, 1997. I am informed that Takahashi qualifies as prior art to the '595

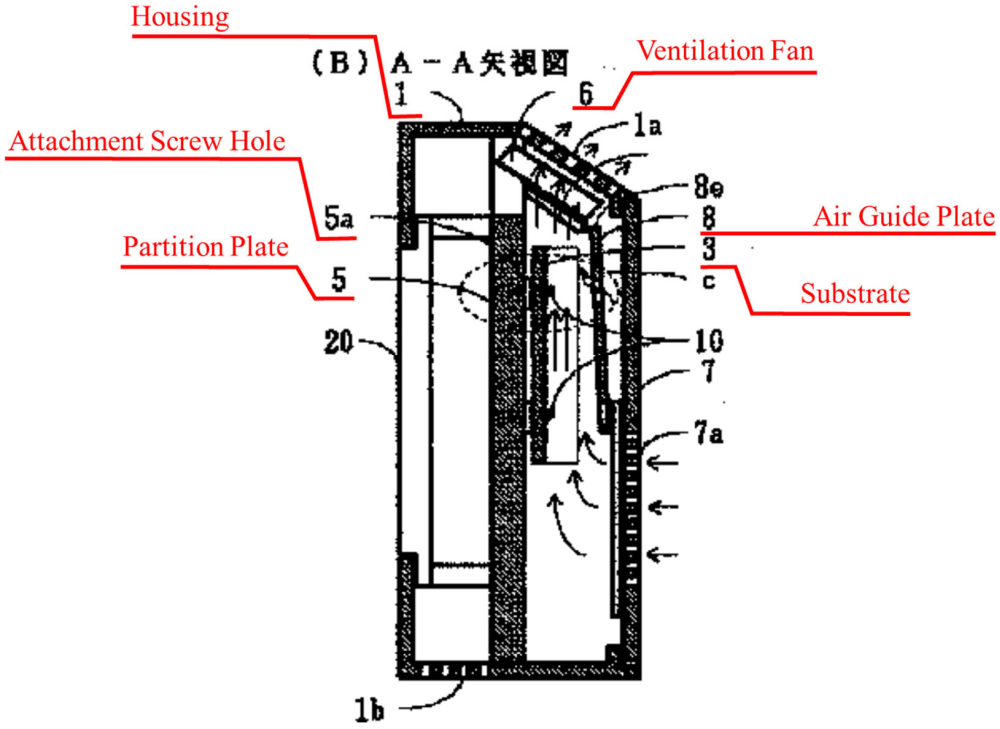
[6] Unless otherwise stated, all citations are to the certified translation of Takahashi (Ex. 1008).

patent pursuant to at least pre-AIA 35 U.S.C. § 102(b) because it was published internationally more than one year before the invention of the '595 patent.

100. Takahashi describes a "a heat dissipation structure for electronics that can prevent air leakage even if a through-hole is provided in the air guide plate." (Ex. 1008, Abstract.)

101. Takahashi is directed to the improvement of airflow control in "the heat dissipation structure of electronic devices such as PDP (plasma display [panel]) devices" (*Id.*, ¶[0002], FIG. 1(B).) In particular, Takahashi discloses an "air leak prevention part [**9**] that is fitted to … through-hole **8a**, which is formed into a hollow body having, as shown in FIG. 2":



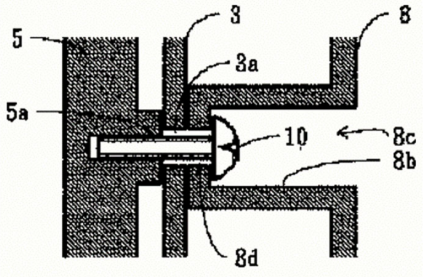


(*Id.*, ¶[0010], FIG. 1(B), 2 (annotated).) The air leak prevention part includes "an opening **9a** corresponding to the aforesaid through-hole **8a**; an insertion hole **9b** for insertion of the substrate attachment screw **10** formed in the base thereof; and a concave part **9c** that fits into the aforesaid through-hole **8a** formed at the peripheral edge of the opening **9a** thereof." (*Id.*) "This concave part **9c** is formed … to improve mating to the through-hole **8a** and to ensure that air leakage is prevented." (*Id.*, ¶[0010].) The "air leak prevention part **9** is fitted into the through-hole **8a** provided in the air guide plate **8**, and the screw **10** is inserted through the opening **9a** in this air leak prevention part **9** and threaded through the attachment screw hole **5a** in the partition plate **5** via the insertion hole **9b** and the insertion hole **3a** in the substrate **3**,

thereby fastening the substrate **3** to the partition plate **5**." (*Id.*, ¶[0012].)

102. As reflected by Figure 3, Takahashi discloses that its "heat dissipation structure for electronics" also allows "the aforesaid air leak prevention part **9** [to be] integrally formed with the aforesaid air guide plate **8**, and, as shown in the drawings, a tubular recess **8b** is formed in the air guide plate **8**, thereby forming an opening **8c**, and an insertion hole **8d** is formed in the base of the same recess **8b**."

【Figure 3】



(*Id.*, ¶[0011], FIG. 3.) The "thin section **8e** formed at the top of the air guide plate **8** is rotated, the air guide plate **8** is lifted up, and the substrate **3** is inserted to the designated position, after which the air guide plate **8** is placed on the substrate **3**, and the mounting screw **10** is inserted into the recess **8b** via the opening **8c**, whereupon it passes through the insertion hole **3a** in the substrate **3** via the insertion hole **8d** provided in the base of this recess **8b**, and is threaded into the attachment screw hole **5a** in the partition plate **5**, thereby fastening the substrate **3** to the partition plate **5**." (*Id.*, ¶[0012].)

VII. GROUND 1: CLAIM 1 IS OBVIOUS OVER TAKEUCHI

A. Independent Claim 1

103. It is my opinion that Takeuchi (Ex. 1004) discloses or renders obvious each and every limitation of Claim 1.

1. "A system for cooling an electronic display having a posterior display surface and contained within a housing, the system comprising:" (Claim Element 1[pre])

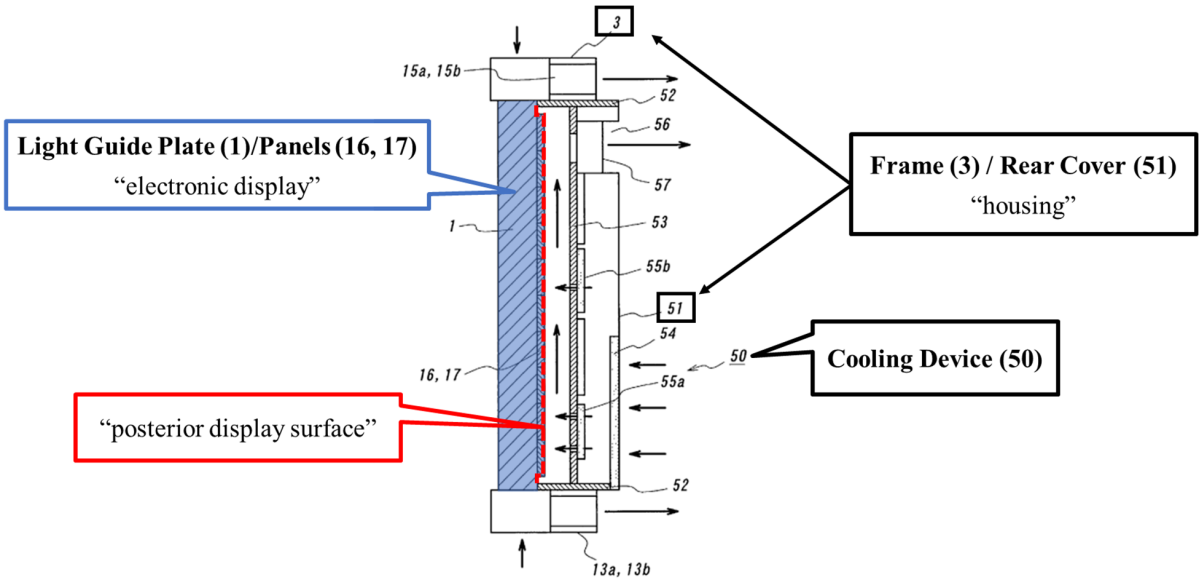
104. To the extent the preamble is limiting, it is disclosed by Takeuchi. Takeuchi discloses "**a system for cooling an electronic display having a posterior display surface and contained within a housing[.]**"

105. Takeuchi is directed to a "display system . . . that includes a novel cooling device."[7] (*Id*., ¶[0002].) Takeuchi's "**electronic display**" system includes a light guide plate and a panel portion arranged on the back side of the light guide

[7] Takeuchi discloses that its "display system" differs from "known liquid crystal display (LCD) or plasma display (PDP) in that it does not basically require a seal structure[,]" such that "it is possible to realize a display system having a divided panel structure that is highly suitable for upsizing and reduction in thickness of the panel without particular difficulties." (Ex. 1004, ¶[0005]; *compare* Ex. 1001, 4:16-25 (describing the various types of electronic displays that are encompassed by the '595 patent, including LCD, LED, OLED, FED, CRT and plasma displays, as well as "displays of other types including those not yet discovered"); *see also id.*, 3:61-63.)

plate that "causes a video image to be displayed on the light guide plate[.]" (*Id.*, Abstract, ¶[0023], FIG. 3.) Takeuchi discloses that its electronic display system "includes a cooling device for controlling flow of a fluid in contact with the back of the [display's] light guide plate **1**, to cool the light guide plate **1** from its backside." (*Id.*, ¶[0035]; *see also id.*, ¶[0045], FIGs. 4, 5.)

106. Takeuchi's electronic display system includes a "**posterior display surface**." In particular, Takeuchi discloses that its **electronic display** includes "light guide plate **1** and panels **16**, **17**[.]" (*Id.*, ¶¶[0037], [0047], FIGs. 4, 5.) As reflected in the annotated figure below, the posterior surface of the light guide plate **1** and panels **16, 17** together comprise a rear-facing surface of the display assembly:



(*Id.*, FIG. 5 (annotated); *see also id.*, ¶¶[0037], [0047], FIG. 4). This rear-facing surface of the display assembly created from "backsides of the light guide plate **1**

and panels **16, 17**" satisfies the Delaware District Court's claim construction for a "**posterior display surface**."

107. Takeuchi's electronic display is contained within a "**housing**," particularly the combination of frame **3** and rear cover **51** shown in Figure 5. Takeuchi discloses that light guide plate **1** and panels **16**, **17** are mounted in the front into frame **3** and are connected using gaskets **29-32**. (*Id.*, ¶¶[0032]-[0033].) Takeuchi further discloses that the backside of rear cover **51** and the inner surface portions of rear cover **51** (denoted as **52**) form a three-sided cover that connects to frame **3** to form a housing which contains the electronic display. (*Id.*, ¶[0040]; *see also id.*, ¶[0036], FIGs. 4, 5.)

108. Accordingly, Takeuchi discloses or renders obvious "**a system for cooling an electronic display having a posterior display surface and contained within a housing**."

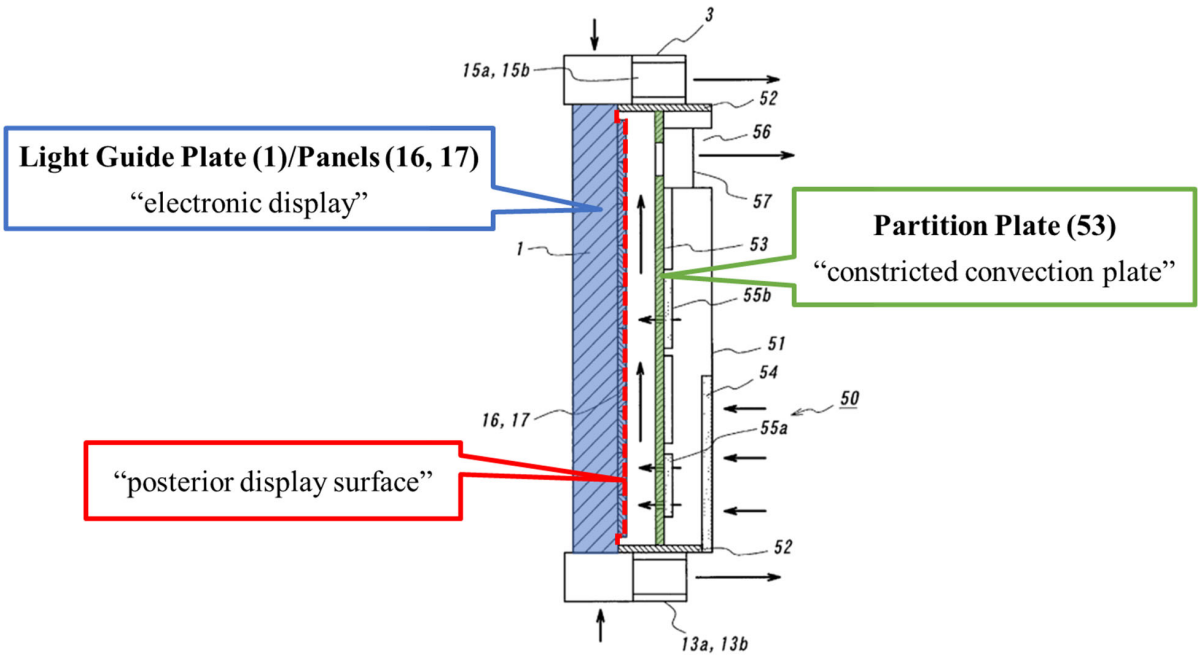
2. "a constricted convection plate placed posterior to the posterior display surface;" (Claim Element 1[a])

109. Takeuchi discloses the requirement of Claim 1 of "**a constricted convection plate placed posterior to the posterior display surface**."

110. Takeuchi discloses a "**posterior display surface**" in the form of "the backsides of the light guide plate **1** and panels **16, 17**" for the reasons explained above in Section VII.A.1 with respect to the preamble of Claim 1.

111. Takeuchi teaches using "a partition plate for forming a flow path of the fluid in contact with the back of the light guide plate at least in a region adjacent to the back of the light guide plate" to cool the display. (Ex. 1004, ¶[0011].) Takeuchi teaches that the "flow path may be formed as a circulation flow path." (*Id.*) Takeuchi's partition plate **53** is "placed between the rear cover **51** and the back sides of the light guide plate **1** and the panels **16**, **17**." (*Id.*, ¶[0040]).

112. In particular, as shown in an annotated illustration of Figure 5 below, the partition plate **53** "defines a cooling chamber on the back sides of the light guide plate 1 and the panels 16, 17 [i.e. **the posterior display surface**], and is advantageously formed of metal material [with a high thermal conductivity] such as aluminum." (*Id.*)



(*Id*., FIG. 5 (annotated).) As also shown in Figure 5, and as Takeuchi discloses, the flat-shaped "partition plate **53** is arranged in parallel with a vertical plane so that the distance between the light guide plate **1** and the panels **16, 17**, on the one hand, and the partition plate **53**, on the other hand, is kept constant as seen in the height direction." (*Id.*, ¶¶[0040], [0047]; FIG. 5.) Because Takeuchi's "partition plate" "limit[s] the flow path of the fluid in contact with the back of the light guide plate[,]" (*id*., ¶[0013]) to facilitate convective heat transfer, it constricts airflow in order to achieve the desired cooling effect.

113. Takeuchi's partition plate **53** is positioned "**posterior to**" the rear-facing surface of the display assembly of the rear cover **51** and the back sides of the light guide plate **1** and the panels **16**, **17**, which is the "**posterior display surface**" as explained above with respect to claim element 1[pre]. (*Supra* VII(A)(1).) The partition plate **53** thus is in exactly the same "posterior position" relative to the backside of the light guide plate **1** and the panels **16**, **17** as is the constricted convection plate **30** relative to the display posterior **22** shown in Figures 3 and 5B-5F of the '595 patent. (Ex. 1001, 4:66-5:5, FIGs. 3, 5B-5F.) Accordingly, Takeuchi's "partition plate **53**" is the claimed "**constricted convection plate**."

114. Accordingly, Takeuchi discloses the requirement of claim 1[a] of "**a constricted convection plate placed posterior to the posterior display surface**."

3. "two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit; and" (Claim Element 1[b])

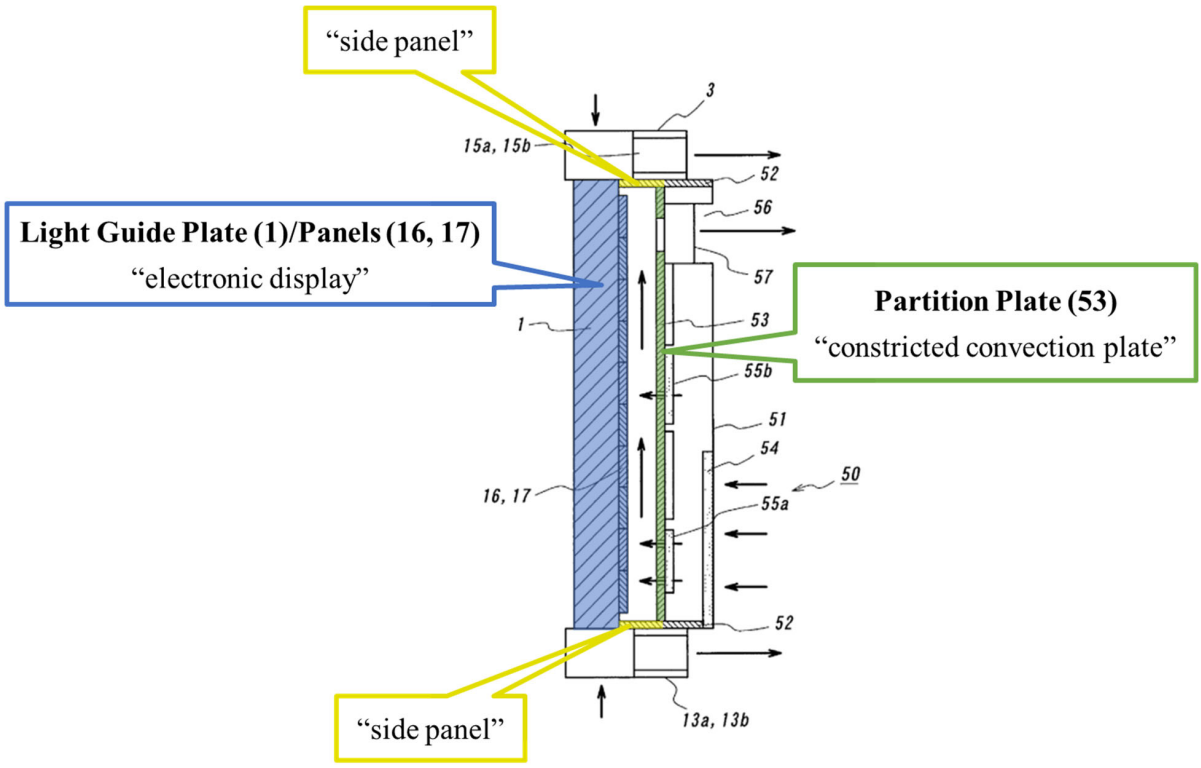
115. Takeuchi discloses or renders obvious the requirement of Claim 1 of "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**."

116. Takeuchi discloses a "**constricted convection plate**," i.e. flat-shaped partition plate **53**, for the reasons discussed above with respect to Claim 1[a]. (*See supra*, § VII.A.2.)

117. Takeuchi further teaches that "[t]he partition plate **53** defines a **cooling chamber** on the back sides of the light guide plate **1** and the panels **16, 17**." (Ex. 1004, ¶[0040]; *see also id.*, ¶[0036], FIG. 5).

118. As reflected by annotated Figure 5 below, Takeuchi's "**cooling chamber**" is constrained by (a) the **posterior display surface** of the light guide plate **1** and the "back sides" of its panels **16, 17**, (b) the partition plate **53** (*i.e.*, **constricted convection plate**, shown in green) placed posterior to the light guide plate **1** and the panels **16, 17**, and (c) "inner surface portions [denoted as **52**] of the rear cover **51** in its upper and lower regions" (which are covered with "thermally insulated materials") and formed at ninety degrees from the partition plate **53** (which inner

surface portions also are shown in yellow) and (d) side panels on the right and left side of the partition plate **53** (not shown in figure):



(*Id*., FIG. 5 (annotated), ¶[0036].) It is my opinion that the inner portions **52** of rear cover **51** together with partition plate **53** defines the constricted convection channel.

119. In addition, a POSITA would have understood that Takeuchi's "**cooling chamber**" is not open to ambient air on its sides left and right and therefore would have understood it to include **two side panels placed adjacent to the constricted convection plate and the posterior display surface** on the right and left sides of the chamber. First, Takeuchi discloses that its "display system may be installed, for example, on a vertical wall of a public facility." (*Id*., ¶[0023].) Accordingly, a

POSITA would have understood that the cooling chamber would need to be enclosed to prevent contaminants from entering. Second, Takeuchi discloses that ambient air is introduced into the cooling chamber "through the filters **54, 55*a*, 55*b*** while removing foreign matters in the ambient air, such as dust." (*Id*., ¶[0041].) In other words, air does not enter through the right and left sides of the chamber. To the extent Takeuchi does not include these side panels, it is my opinion that it would have been obvious to add side panels adjacent to the partition plate and posterior display surface on the right and left sides of the chamber to prevent contamination and improve air flow. Takeuchi thus discloses the requisite "**two side panels adjacent the constricted convection plate and the posterior display surface**."

120. The constricted convection channel in Takeuchi has two entrances and one exit. Takeuchi discloses that "ambient air [is introduced] into the cooling chamber defined by the partition plate **53** through the filters **54**, **55a**, **55b**," and "flows from the lower side toward the upper side of the chamber, cooling the light guide plate **1** and the panels **16, 17** from the backsides[.]" (*Id.*, ¶[0041].) Because air ingested through entrance **55a** warms as it moves through the constricted convection channel, ambient air ingested through entrance **55b** allows light guide plate **1** and the panels **16**, **17** to be cooled "substantially uniformly." (*Id.*) Takeuchi discloses that blower **57** facilitates exit of the warmed air through recess portion **56**.

(*Id.*) Takeuchi teaches that "[t]he ambient air introduced into the cooling chamber flows from the lower side toward the upper side of the chamber, cooling the light guide plate **1** and the panels **16**, **17** from the back sides, and is sucked from the exhaust vent in the upper portion of the partition plate **53** into the blower **57**, and then exhausted from the recess portion **56** [the 'exit'] of the rear cover **51** to outside." (*Id.*; *see also id.*, ¶[0037].)

121. Thus, it is my opinion that Takeuchi's cooling chamber is a "constricted channel through which air may flow to remove heat from the posterior display surface," so as to satisfy the Delaware District Court's claim construction for a "**constricted convection channel**." (Exs. 1011, pp.1-2; 1012, pp.10-11.)

122. Accordingly, Takeuchi discloses or renders obvious the requirement of claim 1 of "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**[.]"

4. "a fan placed to draw air from outside of the housing through the constricted convection channel." (Claim Element 1[c])

123. Takeuchi discloses the requirement of Claim 1 of "**a fan placed to draw air from outside of the housing through the constricted convection channel**."

124. As discussed above with respect to claim element 1[b], Takeuchi discloses a "cooling chamber" that is a "**constricted convection channel**." (*See supra* § VII.A.3; *see also* Ex. 1004, ¶¶[0036], [0040]; FIGs. 4-5.)

125. With reference to Figure 5, Takeuchi discloses that "[a]n exhaust vent and a blower **57** are provided in the upper portion of the partition plate **53**[.]" (*Id*., ¶[0040]; *see also id.*, ¶[0036], FIG. 5.) Takeuchi specifically acknowledges that the blower may be a "**sirocco fan**." (*Id.*, ¶[0040].)

126. Takeuchi teaches that "ambient air introduced into the cooling chamber flows from the lower side toward the upper side of the chamber, cooling the light guide plate **1** and the panels **16, 17** from the back sides, and is sucked from the exhaust vent in the upper portion of the partition plate **53** into the blower **57** [i.e. a '**fan positioned to draw air**'], and then exhausted from the recess portion **56** of the rear cover **51** [i.e. the '**housing**'] to outside." (*Id.*, ¶[0041]; *see also id.*, ¶[0037].) Takeuchi's fan thus draws air from outside the housing and through and out of the cooling chamber (i.e. the "**constricted convection channel**"). (*Id*., FIGs. 4 & 5.)

127. Accordingly, Takeuchi discloses the requirement of Claim 1 of "**a fan placed to draw air from outside of the housing through the constricted convection channel**."

128. For these reasons, it is my opinion that Takeuchi discloses or renders

obvious each and every element of Claim 1, and therefore anticipates Claim 1.

VIII. GROUND 2: CLAIM 1 IS OBVIOUS OVER KIM

A. Independent Claim 1

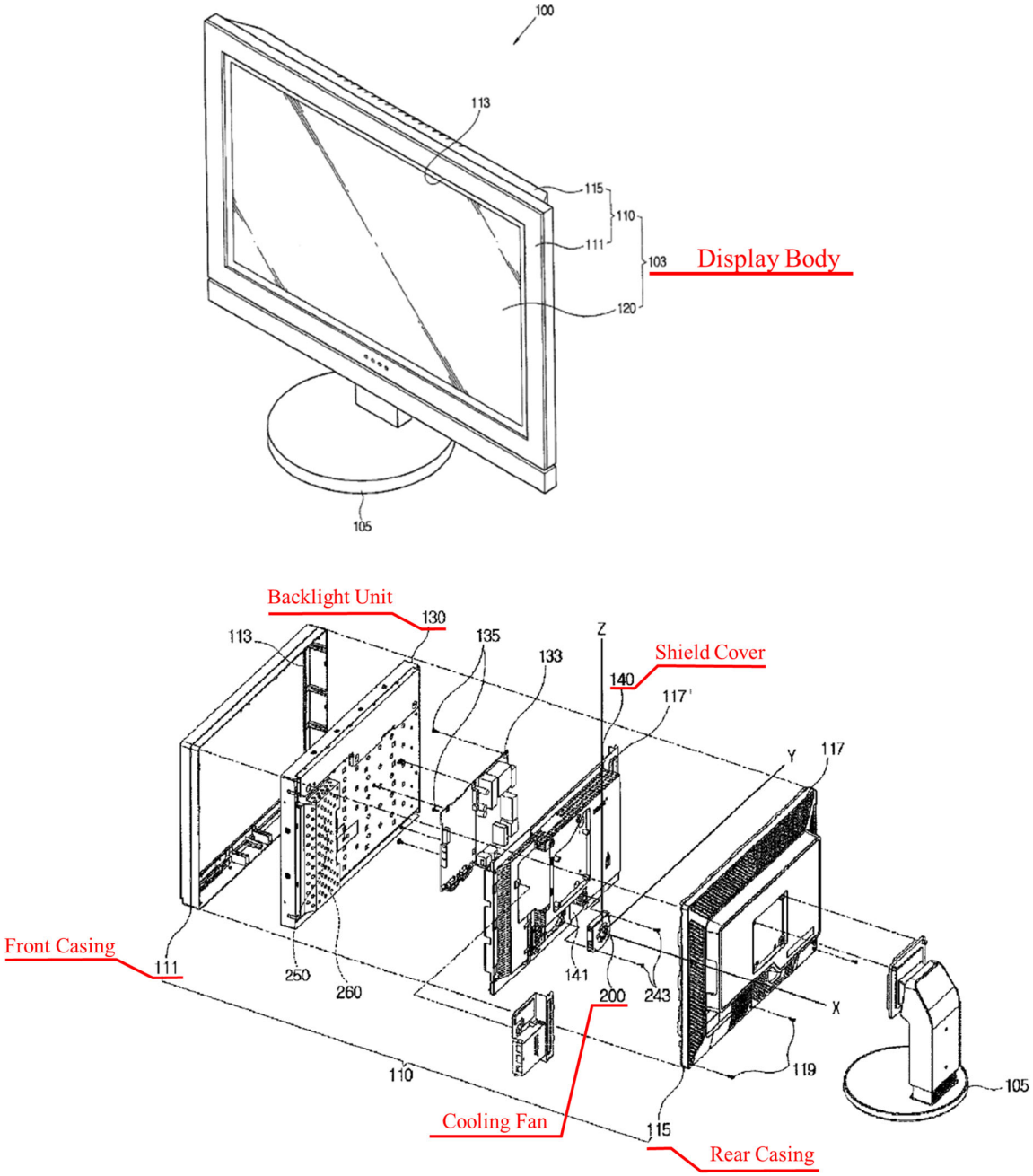
129. It is my opinion that Kim (Ex. 1005) discloses or renders obvious each and every limitation of Claim 1.

1. "A system for cooling an electronic display having a posterior display surface and contained within a housing, the system comprising:" (Claim Element 1[pre])

130. To the extent the preamble is limiting, it is my opinion that Kim discloses or renders obvious "**a system for cooling an electronic display having a posterior display surface and contained within a housing[**.]"

131. Kim discloses "a cooling fan unit that cools a backlight unit of a display apparatus [an '**electronic display having a posterior surface**'] comprising a casing ['**a housing**'], the backlight unit that is supported by the casing and comprises light emitting diodes (LEDs), and a shield cover . . . ." (Ex. 1005, 3:21-30.)

132. Kim's display apparatus may be "a TV or a computer monitor[.]" (*Id.*, 3:64-65.) As reflected by Figures 1 and 2, below, Kim teaches that the "display apparatus **100**" includes a "display body **103** [which] comprises a liquid crystal display panel **120**, a backlight unit **130**, a shield cover **140**, and a cooling fan unit **200.**"



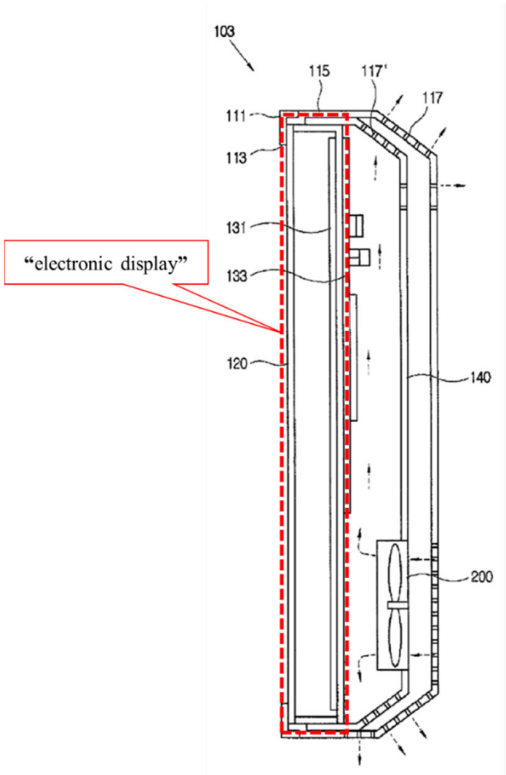
(*Id.*, 4:1-6, FIGs. 1, 2 (annotated).)

133. Kim's display system comprises a "**housing**" in the form of:

> a **casing 110** that accommodates and supports the [LCD] panel **120** and the backlight unit **130** to form an external shape, and comprises a front casing **111** and a rear casing **115**." The front casing **111** "comprises an opening part **113** and supports the [LCD] panel **120** on which an image is displayed." The rear casing **115** "is provided in the lateral and rear side of the [LCD] panel **120** and is combined with the front casing **111**.

(*Id.*, 4:8-18.)

134. Kim discloses that "[t]he backlight unit **130** comprises a plurality of light emitting diodes (LEDs) as a light source **131** . . . that generates light." (*Id.*, 4:33-35). The backlight unit **130** and display panel **120** together are an "electronic display" as shown below.



(*Id.*, FIG. 5 (annotated).)

135. As discussed above, I understand that the District of Delaware construed "**posterior display surface**" to mean "rear-facing surface of the display assembly." (Exs. 1011, p.1; 1012, pp.6-8.) It is my opinion that Kim's backlight unit **130** is a "display assembly" that has such a "rear-facing surface," and thus is a "**posterior display surface**" as construed by the Delaware District Court.

136. Accordingly, Kim discloses or renders obvious "**a system for cooling an electronic display having a posterior display surface and contained within a housing**."

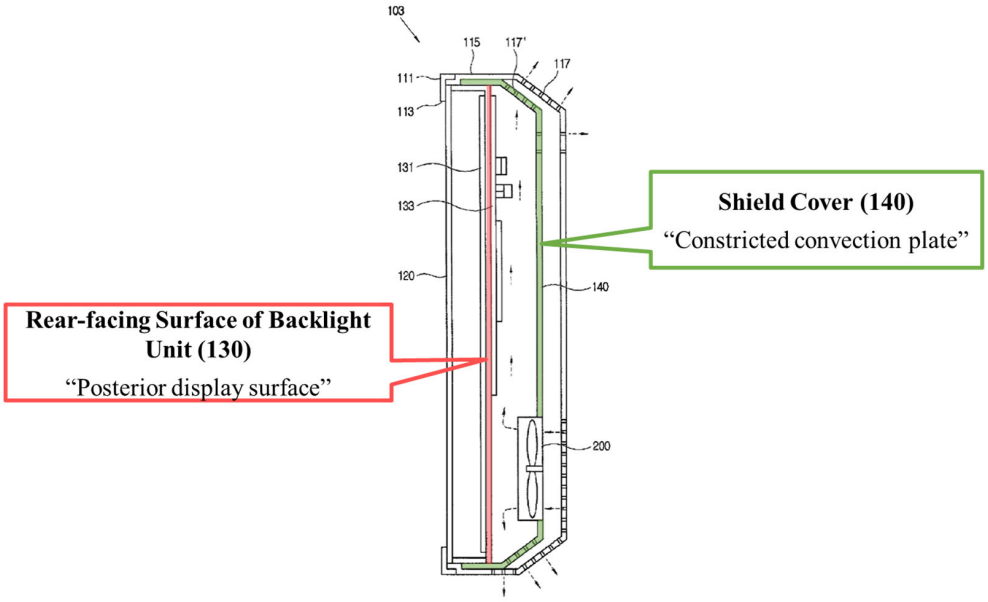
2. "a constricted convection plate placed posterior to the posterior display surface;" (Claim Element 1[a])

137. In my opinion, Kim discloses or renders obvious **"a constricted convection plate placed posterior to the posterior display surface[,]**" as required by claim element 1[a] of the '595 patent.

138. Kim discloses a "**posterior display surface**" of the backlight unit **130** for the reasons explained above with respect to the preamble of Claim 1. (*See supra*, § VIII.A.1.)

139. Kim discloses a "**constricted convection plate**" in the form of "**shield cover 140"** that is "provided in the rear side of the backlight unit **130**," and "is supported by at least one of the backlight unit **130** and the casing **110**, with a space formed between the shield cover **140** and the backlight unit **130**." (Ex. 1005, 4:52-55, FIG. 5.) Kim teaches that "cooling air flows through a space between the shield cover **140** and the backlight unit **130**." (*Id.*, 5:37-38.)

140. As annotated Figure 5 reflects, the shield cover **140** "is provided in the rear side of the backlight unit **130**" (i.e. the "**posterior to the posterior display surface**" of backlight unit **130**):



(*Id.*, 4:52-55; FIG. 5 (annotated); *see also* Exs. 1011, p.1; 1012, pp.6-8.) The "shield cover" combined with a cooling fan "supplies cooling air to the backlight unit." (Ex. 1005, 2:60-61.) Kim discloses that shield cover 140 is configured to efficiently guide the airflow produced by the cooling fan 210:

> The shield cover **140** may have a plurality of air slits **117'** through which flowing air produced by the cooling fan **210** comes in and out. The **shield cover 140** may be formed in diverse shapes such that the **flowing air produced by the cooling fan 210 can be efficiently guided**.

(*Id.*, 4:59-63 (emphasis added).) Because Kim's "shield cover **140**" guides airflow to facilitate convective heat transfer from the backlight, it is my opinion that a POSITA would have understood that the "shield cover **140**" must constrict air

generated by the fan in order to achieve its purpose cooling the backlight. Kim achieves this constricted airflow effect by reducing the volume of the space behind the display panel which allows air from cooling fan **210** to flow across the backlight unit **130**. (*Id*., 5:34-38.)

141. Accordingly, Kim discloses or renders obvious "**a constricted convection plate placed posterior to the posterior display surface**."

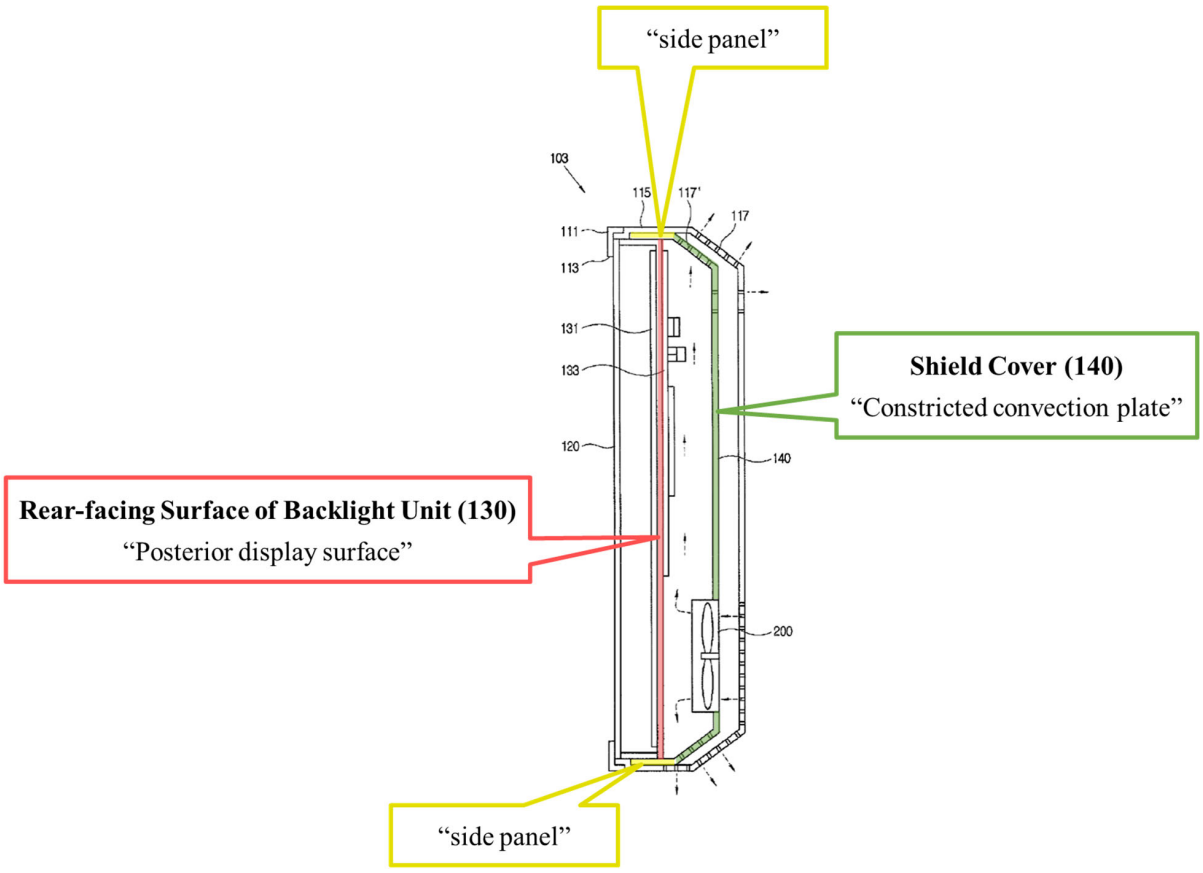
3. "two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit; and" (Claim Element 1[b])

142. Kim discloses or renders obvious "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**[.]"

143. Kim discloses a "**posterior display surface**" and "**constricted convection plate**" for the reasons explained above with respect to the preamble of Claim 1 and claim element 1[a]. (*See supra*, §§ VIII.A.1 & 2.)

144. It is my opinion that Kim discloses two sets of side panels adjacent to the constricted convention plate which define a constricted convection channel. First, shield cover **140** includes portions at the ends which are "supported by at least one of the backlight unit and the casing," (Ex. 1005, Abstract, 4:52-55), and which, along with the rest of the shield cover, completely "covers the backlight unit and the

circuit board." (*Id.*, 2:59-60.) These portions of shield cover **140** (depicted as yellow in annotated Figure 5 below) are the claimed "side panels" because they are adjacent to the shield cover **140** and, along with the rest of the shield cover define a channel that "supplies cooling air to the backlight unit." (*Id.*, Abstract.)

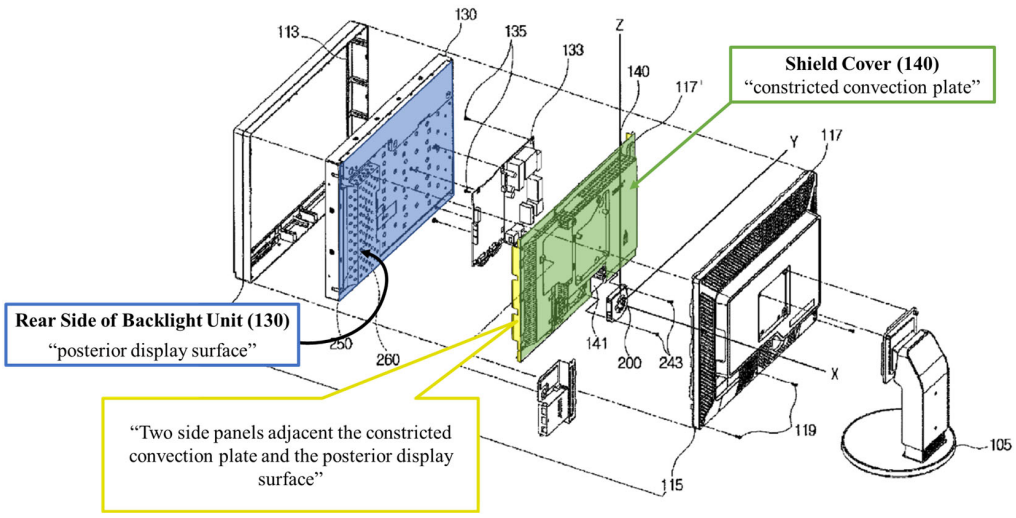


(*Id.*, FIG. 5 (annotated).)

145. To the extent that the portions of the shield cover **140** illustrated in Figures 2 and 5 are not considered side panels, it is my opinion that it would have been obvious to include side panels by widening the constricted convection channel

to facilitate greater clearance (and air movement) between the electrical components mounted to part of the rear of the display and the shield cover.

146. In addition, Figure 2 discloses a set of side panels placed at 90 degree angles to the right and left of shield cover **140** which are adjacent to the shield cover **140** and, like the example in the specification of the '595 patent discussed above (*supra* ¶61), extend from shield cover **140** (constricted convection plate) and make contact with the rear facing surface of backlight **130** (posterior display surface), thereby directing air through the constricted convection channel.



(Ex. 1005, FIG. 2 (annotated).)

147. It is my opinion that, along with the shield cover **140**, both sets of side channels define a "constricted channel through which air may flow to remove heat from the posterior display surface," satisfying the Delaware District Court's claim

construction for a "**constricted convection channel**." (Exs. 1011, pp. 1-2; 1012, pp.10-11.) Air is drawn "in and out" of the channel through air slits **117′**. (Ex. 1005, 4:59-61.) The air slits **117′** are located at the top and bottom of the constricted convection plate (the shield plate is bordered by a finned heat sink on each side). (*Id.*, FIG 2.) The "cooling air generated by" a cooling fan **210** therefore "can efficiently cool the LEDs widely distributed on the plane of the backlight unit **130** and the circuit board **133** while the cooling air flows through a space between the shield cover **140** and the backlight unit **130**." (*Id.*, 5:34-38, FIGs. 2 & 5.)

148. The air slits **117′** constitute the "**entrance**" and "**exit**" to the constricted convection channel. With respect to the Figure 2 embodiment, Kim discloses that ambient air enters the constricted convection channel through fan **210** and exits through the plurality of air slits **117′** located on either end of the cooling channel. (*Id.*, 7:57-62, FIGs. 2 & 5.) However, Kim further discloses that "[t]he intake and discharge directions of the air through the cooling fan **210** may be changed in various ways according to the arrangement of the heat generating parts, the number of cooling fans **210**, etc." (*Id.*, 7:62-65.) In addition, Kim discloses that "[t]he cooling fan **210** may draw in the cooling air from the outside into the heat generating parts or discharge the cooling air to the outside through the heat generating parts depending on its rotation direction." (*Id.*, 5:42-45.) Accordingly, a POSITA would

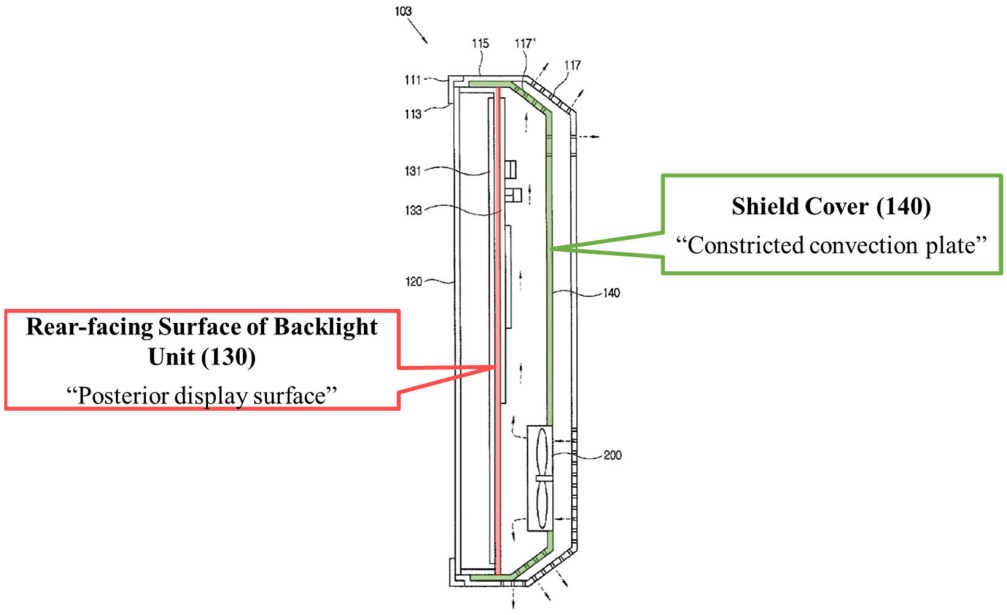
have understood that Kim's air slits **117′** can function as "**entrances**" or "**exits**" depending on the intake and discharge directions of the fan.

149. Accordingly, Kim discloses or renders obvious "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit[**.]"

4. "a fan placed to draw air from outside of the housing through the constricted convection channel." (Claim Element 1[c])

150. In my opinion, Kim discloses or renders obvious "**a fan placed to draw air from outside of the housing through the constricted convection channel**," as required by Claim 1 of the '595 patent.

151. Kim discloses "cooling fan unit **200"** that is "combined to the shield cover **140** to cool the heat generating parts such as the light source **131** and the circuit board **133** of the backlight unit **130**." (Ex. 1005, 5:16-18, FIG. 5). The "cooling fan unit **200** comprises the cooling fan **210** and a fan cover **220**." (*Id*., 5:19-20.) While Kim explains that Figures 2 and 5 "show the cooling fan unit **200** placed in a lower central portion of the shield cover **140**[,]" as an alternative, "the cooling fan may be placed in a central portion or an upper portion of the shield cover **140**, if necessary." (*Id.*, 5:40-42.)



(*Id.*, FIG. 5 (annotated).)

152. Kim teaches that "[t]he cooling fan **210** may **draw in the cooling air from the outside** into the heat generating parts or **discharge the cooling air to the outside** through the heat generating parts **depending on its rotation direction**." (*Id.*, 5:42-45 (emphasis added).) Kim further teaches, "[t]he intake and discharge directions of the air through the cooling fan **210** may be changed in various ways according to the arrangement of the heat generating parts, the number of cooling fans **210**, etc." (*Id.*, 7:62-65; *see also id.*, 5:4-6.) For example, "[t]he cooling fan

250[8] of the display apparatus according to the exemplary embodiment may be provided to have a structure in which external air is discharged to the outside through the cooling fan **250** via the heat generating parts . . . ." (*Id*., 8:16-20.) Accordingly, a POSITA would have understood Kim to disclose or render obvious a fan that draws air from outside the housing and through and out of the "**constricted convection channel.**"

153. Accordingly, Kim discloses or renders obvious "**a fan placed to draw air from outside of the housing through the constricted convection channel**."

154. For these reasons, it is my opinion that Kim discloses or renders obvious each and every limitation of Claim 1.

IX. GROUND 3: THE COMBINATION OF KIM AND HONG RENDERS OBVIOUS CLAIMS 4 AND 7

A. Independent Claim 4

155. It is my opinion that the combination of Kim and Hong renders obvious each and every limitation of Claim 4. In particular, Kim discloses all of the

[8] A POSITA would have understood the reference to "cooling fan **250**" in column 8, lines 16-20 of Kim to be a typographical error. Earlier in its specification, Kim repeatedly uses reference number 250 to identify a "power supply." (*See* Ex. 1005, 6:64-7:7.) As such, a POSITA would have understood Kim to be referring to "cooling fan **210**" in this passage.

limitations of claim 4 except the use of a metal core circuit board (MCPCB) to which a plurality of LEDs is mounted on the front side, which is disclosed in Hong as discussed *infra*, Section IX.A.3. And as I discuss *infra*, Section IX.A.7, a POSITA would be motivated to use an MCPCB to provide enhanced thermal transfer when using higher power LEDs. Hong discloses the use of an MCPCB to which a plurality of LEDs is mounted. A POSITA would be motivated to apply the MCPCB of Hong to further reduce the LED junction temperature and provide a more stable source for illuminating Kim's liquid crystal device and backlight unit.

156. Accordingly, it is my opinion that Kim in combination with Hong renders obvious each and every limitation of independent claim 4 as discussed below.

1. "A liquid crystal display (LCD) comprising:" (Claim Element 4[pre])

157. To the extent the preamble of claim 4 is limiting, the combination of Kim and Hong renders obvious a "**a liquid crystal display (LCD)**."

158. Specifically, Kim discloses:

> As shown in FIGS. 1 to 6, **a display apparatus 100** according to an exemplary embodiment of the present invention generally **comprises a display body 103** and a stand 105 that supports the display body **103**. **The display body 103 comprises a liquid crystal display [LCD] panel 120**, a backlight unit **130**, a shield cover **140**, and a cooling fan

unit **200**.

(Ex. 1005, 4:1-6 (emphasis added).)

159. Accordingly, the combination of Kim and Hong renders obvious a "**a liquid crystal display (LCD)**" as required by the preamble of claim 4.

2. "a liquid crystal stack;" (Claim Element 4[a])

160. The combination of Kim and Hong renders obvious "**a liquid crystal stack**" as required by claim element 4[a].

161. Kim discloses that **"[t]he liquid crystal display panel 120** forms an image and displays the formed image through the opening part **113**." (Ex. 1005, 4:26-28; *see also id.*, Abstract, 1:57-67, 2:47-57, 7:10-15.) A POSITA would have understood that an LCD panel comprises a liquid crystal stack.[9] (*Supra* ¶41.) Kim further discloses an LCD stack in an LCD panel (e.g., LCD panel **840**). Further, if the term "**liquid crystal stack**" is intended to refer to the individual liquid crystal sub-layers (which, when stacked together, collectively form the liquid crystal layer of an LCD panel), a POSITA would know that these liquid crystal sub-layers are necessarily present in a liquid crystal layer of every LCD panel as part of its inherent

[9] Notably the specification of the '595 patent does not define the term "liquid crystal stack," but states the "display **10** may be the front glass plate of a liquid crystal display stack." (Ex. 1001, 9:19-21.)

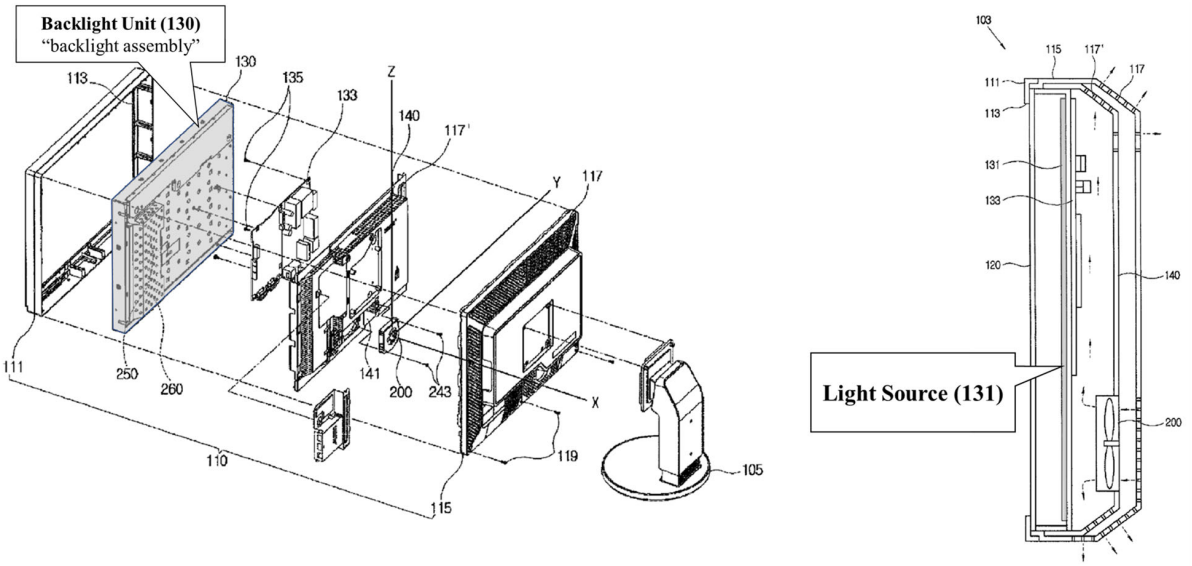
structure.

162. Accordingly, the combination of Kim and Hong renders obvious a "**liquid crystal stack**" as required by claim element 4[a].

3. "a backlight assembly behind the liquid crystal stack and comprising: a metal core printed circuit board (PCB) having front and back sides; a plurality of LEDs mounted on the front side of the PCB; a posterior surface on the rear side of the PCB;" (Claim Element 4[b])

163. Kim in combination with Hong renders obvious the limitations of claim element 4[b].

164. Kim discloses a backlight unit **130** ("**a backlight assembly**") that "is provided **behind** the liquid crystal display panel and has a light source [**131**] that emits light[.]" (*See, e.g.*, Ex. 1005, 1:62-63, 2:51-54 (emphasis added).) As seen in the annotated Figures 2 and 5 below, the **backlight assembly** is located behind the LCD ("**the liquid crystal stack**"):

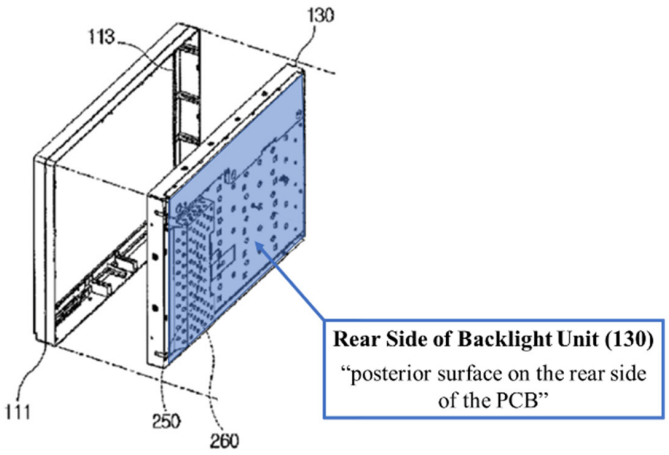


(*Id*., FIGs. 2, 5 (annotated).)

165. Kim discloses that "[t]he backlight unit **130** comprises **a plurality of light emitting diodes (LEDs)** as a light source **131** . . . that generates light." (*Id*., 4:33-35 (emphasis added).) Additionally, Kim discloses that the "LEDs [are] **widely distributed on the plane of the backlight unit 130 and the circuit board 133**[.]" (*Id*., 5:35-36 (emphasis added).) A POSITA would recognize, therefore, that the LEDs must be mounted on a first side of a PCB included as part of the backlight unit **131**. A POSITA also would recognize that this PCB has a front and back side. Accordingly, Kim discloses "**a printed circuit board (PCB) having front and back sides**."

166. Finally, Kim discloses "a **posterior surface on the rear side of the**

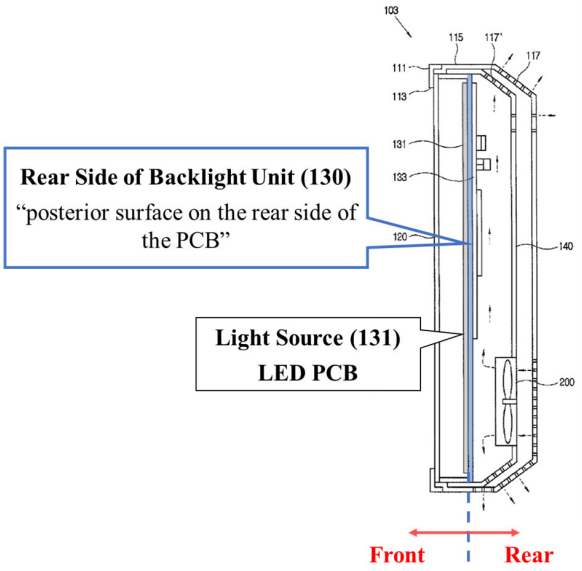
PCB."[10] As depicted in annotated Figure 5 from Kim, the LED PCB has a front side and a rear side where directions "front" and "rear" correspond to the LCD panel front (viewing side) of the display and a rear (posterior) side of the display, respectively:



[10] I further note that the '595 patent states:

> The PCB may comprise a metal core PCB and **the posterior surface of the PCB** may be metallic so that air within the constricted convection channel may cool the **metallic posterior surface** (and subsequently the backlight assembly) more easily and efficiently.

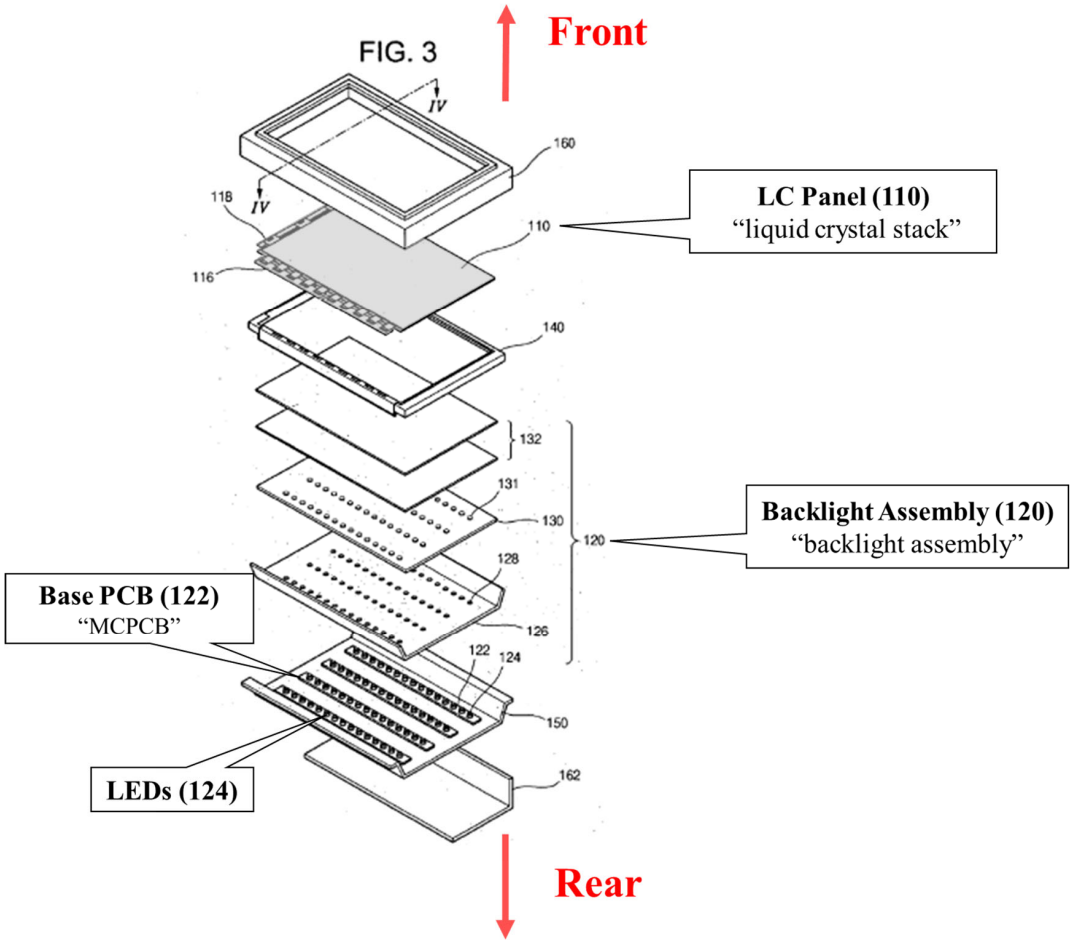
(Ex. 1001, 4:60-65 (emphasis added).) Accordingly, a POSITA would have understood from the '595 patent's disclosure that **the rear outmost surface** of a PCB is the claimed "**posterior surface.**"



(*Id.*, 4:52-55, FIG. 2 (partial) (annotated), FIG. 5 (annotated).) Therefore, Kim discloses a posterior surface on the rear side of the PCB. Alternatively, it is my opinion that the rear panel of the backlight unit **130** also is a **posterior surface on the rear side of the PCB**, as shown above.

167. Hong discloses an LCD device that includes "a backlight assembly **120** and a liquid crystal panel **110** [which] may be disposed over an inner surface of a bottom case **150**." (Ex. 1006, ¶[0025].) As shown in annotated Figure 3 below, the backlight assembly **120** includes a base PCB **122**, which "is placed on an inner surface of the bottom case **150**[.]" (*Id.*, ¶[0033].) "The peripheral portion of the liquid crystal panel **110** is placed on the main supporter **140**," and "[t]he top cover **160** surrounds the liquid crystal panel **110**." (*Id.*) A POSITA would have understood this disclosure to mean that the backlight assembly **120** is necessarily

disposed behind the liquid crystal panel **110**.



(Ex. 1006, ¶¶[0029], [0033], FIG. 3 (annotated).) Therefore, Hong discloses a backlight assembly **120** that is "**behind the liquid crystal stack**."

168. Hong discloses in reference to Figure 3 that "[t]he backlight assembly **120** includes a plurality of LEDs **124**," which "may be arranged on a plurality of base PCBs **122**." (*Id.*, ¶[0029], Fig. 3.) Hong discloses that:

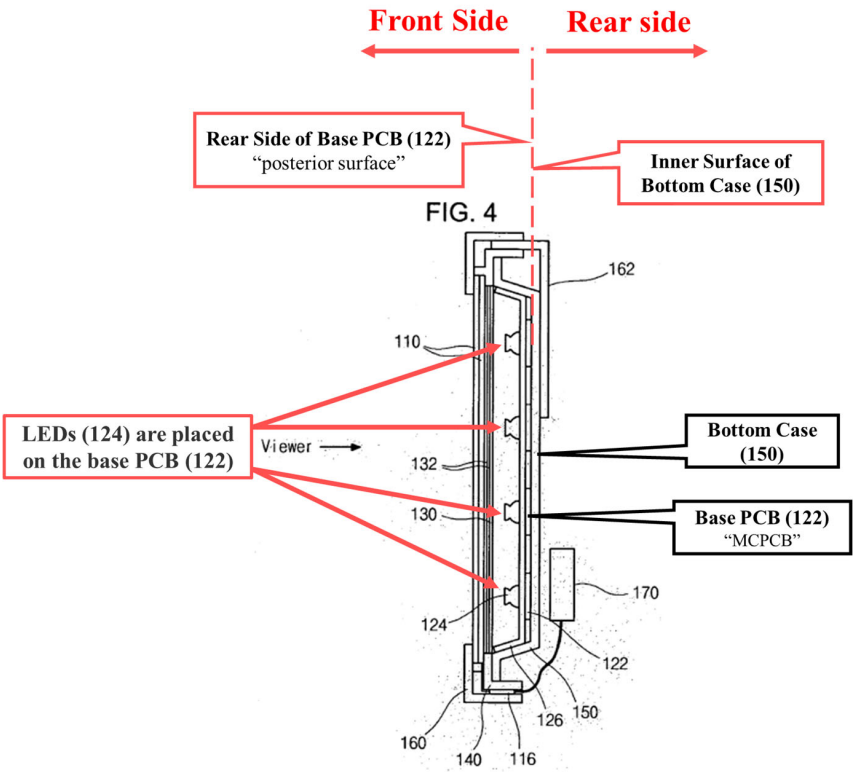
The base PCB 122 may include a MCPCB (metal core printed

> **circuit board)** which may effectively absorb and transfer heat produced at the LED **124**.

(*Id*., ¶[0029] (emphasis added).)

169. Hong discloses that "the base PCB **122** is placed on an inner surface of the bottom case **150**, and the LEDs **124** are placed on the base PCB **122**." (*Id.*, ¶[0033].) Thus, Hong discloses a "**back side**" of the PCB, which faces the inner surface of the bottom case **150** and a "**front side**" of the PCB, on which a plurality of LEDs **124** are mounted. Accordingly, Hong discloses "**a metal core printed circuit board (PCB) having front and back sides**."

170. Hong likewise discloses "**a plurality of LEDs mounted on the front side of the PCB**." Hong discloses that "[t]he backlight assembly **120** includes a plurality of LEDs **124**" and that "[t]he LEDs **124** may be arranged on a plurality of base PCBs **122**." (*Id.*, ¶[0029.) Hong further discloses that "the base PCB **122** is placed on an inner surface of the bottom case **150**, and the LEDs **124** are placed on the base PCB **122**." (*Id.*, ¶[0033].) A POSITA would have understood this to mean that the LEDs **124** are mounted on the "**front side of the PCB**," as shown in annotated Figure 4: :



(*Id.*, FIG. 4 (annotated).) Since each one of Hong's "backlight assembly **120** includes a plurality of LEDs **124**" which "may be arranged on a plurality of base PCBs **122**," Hong discloses "**a plurality of LEDs mounted on the front side of the PCB**." (*Id.*, ¶[0029].)

171. Similarly, Hong's metal core PCB has a "**back side**," which is the side of the PCB **122** which "is placed on an inner surface of the bottom case **150**" and a "**front side**," which is the surface of the PCB **122** on which the LEDs **124** are mounted, as shown in Figure 4. (*Id.*, ¶[0033].)

172. For these reasons, the combination of Kim and Hong renders obvious

"**a backlight assembly behind the liquid crystal stack and comprising: a metal core printed circuit board (PCB) having front and back sides; a plurality of LEDs mounted on the front side of the PCB; a posterior surface on the rear side of the PCB**," as required by claim element 4[b].

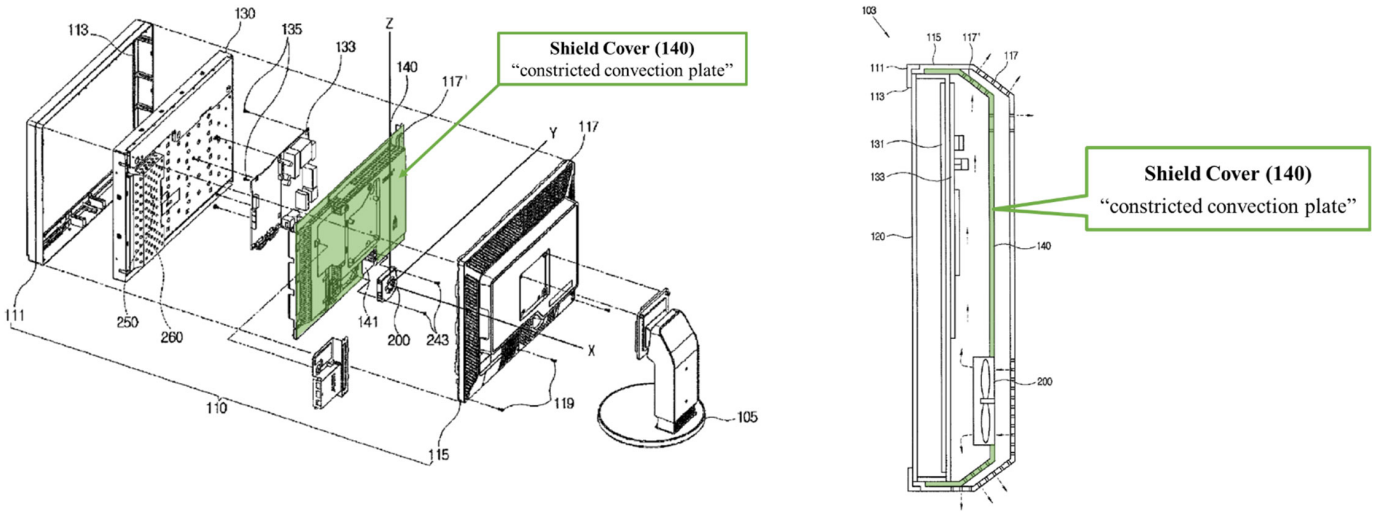
4. "a constricted convection plate placed behind the posterior surface of the PCB, defining a constricted convection channel having an entrance and an exit; and" (Claim Element 4[c])

173. Kim in combination with Hong renders obvious "**a constricted convection plate placed behind the posterior surface of the PCB, defining a constricted convection channel having an entrance and an exit**" as required by claim element 4[c].

174. Kim discloses "**a constricted convection plate**" and "**a constricted convection channel having an entrance and an exit**" for the reasons provided in the discussion above in Ground 2 with respect to claim elements 1[a] and [b]. (*See supra*, §§ VIII.A.2 & 3.) Specifically, as I explained above, Kim discloses claim element 1[b], "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**."

175. Kim further discloses a shield cover **140** ("**constricted convection plate**") that is located in a posterior position to the backside of the PCB to which the

LEDs are mounted as part of backlight unit **130**:



(Ex. 1005, FIGs. 2 and 5 (annotated).) A POSITA would recognize that the PCB to which the LEDs are mounted as part of backlight unit **130** has a front and a back side. Accordingly, the combination of Kim and Hong renders obvious **"a constricted convection plate placed behind the posterior surface of the PCB, defining a constricted convection channel having an entrance and an exit**" as recited in claim element 4[c].

5. "a fan positioned to draw air through the constricted convection channel." (Claim Element 4[d])

176. It is my opinion that the combination of Kim and Hong renders obvious "**a fan positioned to draw air through the constricted convection channel**," as required by claim 4[d] of the '595 patent, for the same reasons provided above in

Ground 2 in the discussion of claim limitation 1[c]. (*See supra*, § VII.A.4.)

177. For these reasons, the combination of Kim and Hong renders obvious claim 4.

6. "The LCD from claim 4 wherein: the fan is placed near the exit of the constricted convection channel;" (Claim 7)

178. Kim in combination with Hong discloses or renders obvious Claim 4 for the reasons provided above. It is my opinion that Kim in combination with Hong renders obvious "**[t]he LCD from claim 4 wherein: the fan is placed near the exit of the constricted convection channel**" as required by claim 7 of the '595 patent.

179. As I explained above in the discussion of limitations 1[b]-[c] in Ground 2, Kim discloses a "**fan**," and an "**exit**" of a **"constricted convection channel**." (*See supra*, §§ VIII.A.3 & 4.) As further discussed above in relation to claim 1[c] in Ground 2, Kim discloses that "[t]he intake and discharge directions of the air through the cooling fan **210** may be changed in various ways according to the arrangement of the heat generating parts, the number of cooling fans **210**, etc." (Ex. 1005, 7:62-65; *see also id.*, 5:4-6.) Kim also discloses that while Figures 2 and 5 "show the cooling fan unit **200** placed in a lower central portion of the shield cover **140**," as an alternative, "the cooling fan may be played in a central portion or an upper portion of the shield cover **140**, if necessary." (*Id.*, 5:38-42.)

180. Accordingly, Kim in combination with Hong renders obvious that "**the fan is placed near the exit of the constricted convection channel**" as required by claim 7.

7. Motivation to Combine Kim and Hong

181. In my opinion, a POSITA as of March 3, 2008 would have been motivated to modify Kim's backlight unit (Ex. 1005, 4:33-35, 4:41-46), to take advantage of Hong's MCPCB with multiple LEDs mounted to its front side. (Ex. 1006, ¶¶[0029], [0033].) In particular, a POSITA would be motivated to use Hong's thermally efficient design of mounting LEDs on a metal core PCB in place of the PCB in Kim in order to permit Kim's cooling chamber to transfer the heat of Kim's backlight more efficiently. Additional motivation would include the desire to cool higher power LEDs which benefit more from the use of MCPCBs. As noted in Hong, "a MCPCB [] may effectively absorb and transfer heat produced at the LED 124." (Ex. 1006, ¶¶[0029].)

182. Both Kim and Hong use circuit boards located behind (below) an LCD panel containing a plurality of LEDs to power the relevant backlight units. (Ex. 1005, 4:33-41, 5:34-38; Ex. 1006, ¶¶[0025], [0029], [0033].) And while Kim discloses a system for cooling the various heat-generating components of the backlight unit of an LCD (Ex. 1005 5:34-46; 7:53-8:3; FIGs. 2&5), Kim does not

expressly recite use of an MCPCB. As discussed in ¶¶ 55-56 above, the use of a metal core printed circuit board would be a well-known design choice subject to technical and cost considerations. A POSITA would have been aware of the benefits associated with using an MCPCB to reduce LED junction temperatures. In particular, one of the dominant suppliers at the time, Lumileds, recommended their use when specifying high power (~>1W) LEDs in an application. (Ex. 1023.) In fact, Lumileds indicates that all Level 2 Luxeon products at least as of 2006 were mounted on an MCPCB. (Ex. 1024, p.2.) Knowing the importance of controlling LED junction temperature by providing high conductivity thermal pathways, a POSITA would have been motivated to consider the use of MCPCBs. In doing so, a POSITA would have looked to modify Kim with Hong, which discloses how an MCPCB with LEDs can be advantageously used (Ex. 1006, ¶[0029].)

183. Kim's and Hong's solutions thus are complementary and aimed at producing more energy efficient LCD devices that reduce component temperatures in the backlight unit.

184. The substitution of Kim's circuit board with Hong's metal core PCB with multiple LEDs mounted to its front side would have involved the use of one known technique to improve similar devices in the same way, and further would have produced predictable results. A POSITA in March 2008 would have been

motivated to employ Kim's solution for removing air heated by the backlight unit to outside that housing via a constricted convection channel along with Hong's more thermally efficient MCPCB, because the combination combines known prior art methods to yield predictable results. A POSITA would have had a reasonable expectation of success from taking advantage not only of Kim's use of the constricted convection channel to discharge air heated by the backlight unit to outside the housing, but also Hong's more efficient use of a metal core PCB that improves thermal efficiency. A POSITA could have combined each of these two known solutions with no change in their respective functions, and the combination would yield predictable results.

185. A POSITA would have understood that it would be advantageous to use Kim's methodology for employing a constricted convection channel to cool the backlight unit, by modifying it with Hong's MCPCB for use with higher power LEDs, the combination would have constituted the simple use of one known technique (the cooling of the posterior display surface of an LCD display by convection of air within a constricted convection channel) as reflected by Kim, by another known technique (utilization of a MCPCB that mounts the LEDs) as disclosed by Hong, with predictable results that the combination would make the LED display more energy efficient as a whole. Kim's cooling methodology would

function in the same way as before but would be improved by the substitution of a commercially available and thermally more efficient metal core circuit board. A POSITA would have had a reasonable expectation of success that the combination of the two complimentary cooling mechanisms (improved thermal conduction, and convection) would work together as intended. A POSITA would have had a reasonable expectation of success from such a combination.

X. GROUND 4: THE COMBINATION OF KIM, HONG, AND TAKAHASHI RENDERS OBVIOUS CLAIM 8

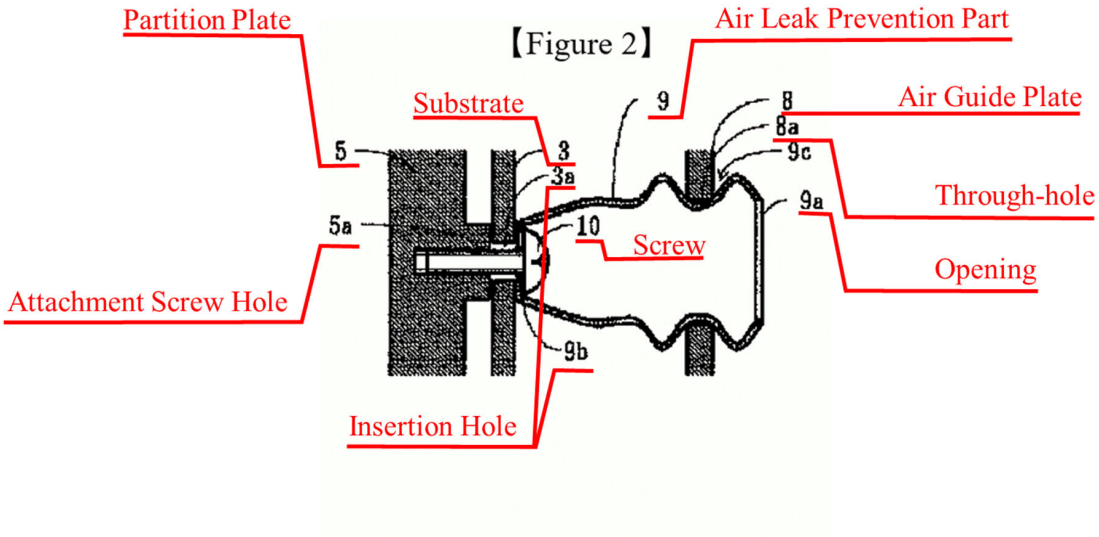
186. It is my opinion that Kim and Hong further combined with Takahashi renders obvious dependent claim 8, as discussed below.

A. "The LCD from claim 4 further comprising: a plurality of access apertures through the constricted convection plate;" (Claim 8)

187. The combination of Kim and Hong renders obvious the limitations of claim 4 for the reasons discussed above. (*See supra* § IX.) In my opinion, the combination of Kim, Hong, and Takahashi discloses "**a plurality of access apertures through the constricted convection plate**," as required by claim 8 of the '595 patent.

188. Kim discloses a **"constricted convection plate**" for the reasons discussed above with respect to claim elements 1[a] and 4[c]. (*See supra*, §§ VIII.A.2, IX.A.4.)

189. Takahashi further discloses as part of a "heat dissipation structure of electronic devices" such as "PDP (plasma display) devices" and "air leak prevention part [**9**] that is fitted to . . . through-hole **8a**, which is formed into a hollow body having, as shown in FIG. 2":

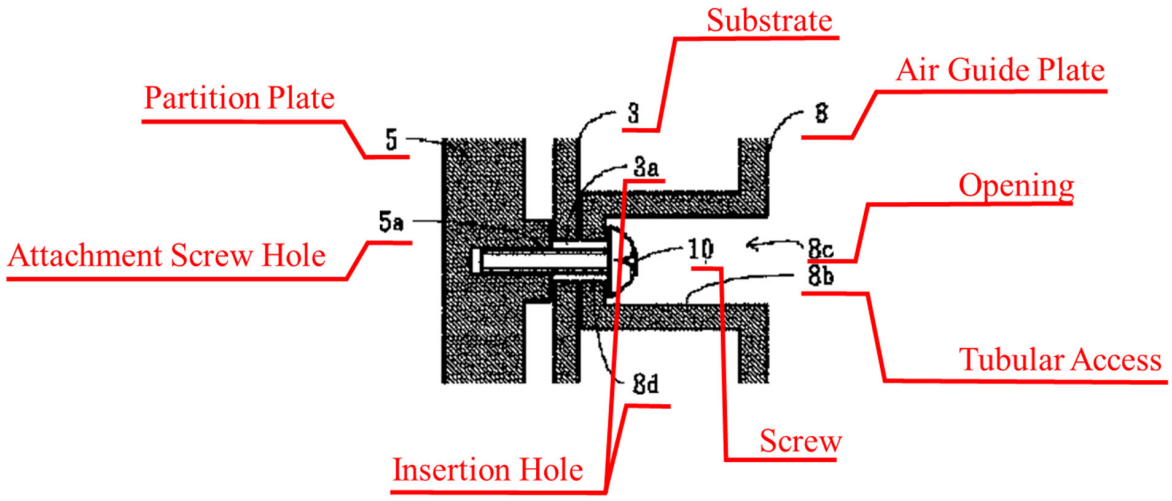


(Ex. 1008, Abstract, ¶¶[0003], [0010], FIG. 2 (annotated).[11]) The air leak prevention part includes "an opening **9a** corresponding to the aforesaid through-hole **8a**; an insertion hole **9b** for insertion of the substrate attachment screw **10** formed in the base thereof; and a concave part **9c** that fits into the aforesaid through-hole **8a** formed at the peripheral edge of the opening **9a** thereof." (*Id.*, ¶[0010].)

190. As further reflected by Figure 3, Takahashi discloses that its "heat dissipation structure for electronics" also allows "the aforesaid air leak prevention

[11] References to elements in Takahashi's patent figures have been bolded.

part **9** [to be] integrally formed with the aforesaid air guide plate **8**, and, as shown in the drawings, a tubular recess **8b** is formed in the air guide plate **8**, thereby forming an opening **8c**, and an insertion hole **8d** is formed in the base of the same recess **8b**.":



(*Id.*, ¶[0011], FIG. 3 (annotated.) The "thin section **8e** formed at the top of the air guide plate **8** is rotated, the air guide plate **8** is lifted up, and the substrate **3** is inserted to the designated position, after which the air guide plate **8** is placed on the substrate **3**, and the mounting screw **10** is inserted into the recess **8b** via the opening **8c**, whereupon it passes through the insertion hole **3a** in the substrate **3** via the insertion hole **8d** provided in the base of this recess **8b**, and is threaded into the attachment screw hole **5a** in the partition plate **5**, thereby fastening the substrate **3** to the partition plate **5**." (*Id.*, ¶[0012].)

191. It is my opinion that a POSITA would consider Takahashi's through-holes **3a** and **8a**, and insertion holes **8d** and **9b** to be "a plurality of **access**

apertures," in that each hole allows "access" to screw 10. This allows an individual to service or replace an electrical component (*e.g.*, substrate 3) associated with an electronic device such as a plasma display television or LCD, such as those disclosed by Kim and Hong. Takahashi further discloses that its "air leak prevention part **9** is fitted into the through-hole **8a** provided in the air guide plate **8**, and the screw **10** is inserted through the opening **9a** in this air leak prevention part **9** and threaded through the attachment screw hole **5a** in the partition plate **5** via the insertion hole **9b** and the insertion hole **3a** in the substrate **3**, thereby fastening the substrate **3** to the partition plate **5**." (*Id.*, ¶[0012].) Because Takahashi contemplates that a through-hole **8a** can be used to fasten a substrate **3** to a partition plate **5**, it would be obvious to a POSITA that these through-holes (i.e. a plurality of **access apertures**), formed from the combination of Kim and Hong, could also be used to gain access through a constricted convection plate, such as Kim's shield cover **140**, to gain access to and service electrical components associated with heat-generating parts such as the LED driver board **133** (which is between the shield cover **140** and the backlight **130** and otherwise obscured).

192. Accordingly, Kim combined with Hong and further combined with Takahashi discloses or renders obvious "**[t]he LCD from claim 4 further comprising: a plurality of access apertures through the constricted convection**

plate" as required by claim 8.

B. Motivation to Combine Kim and Hong with Takahashi

193. It is my opinion that a POSITA would have been motivated to further combine Kim and Hong with Takahashi for the following reasons.

194. In my opinion, a POSITA as of March 3, 2008 would have been motivated to use Kim's "cooling fan with improved cooling efficiency by efficiently cooling [*i.e.* removing] heat generated by a backlight unit" (Ex. 1005, 1:46-49), and to modify its disclosed use to adapt the display for a higher power LED backlight by taking advantage of Hong's MCPCB which provides a more thermally efficient design for heat dissipating components. (Ex. 1006, ¶[0029].) A POSITA would have been further motivated to use Takahashi's solution of using access apertures (i.e. through-holes) to gain access to hardware components associated with the backlight unit and/or LCD display, and especially to prevent cooling air leakage from holes formed in the shield plate **140**. (Ex. 1008, Abstract, ¶¶[0003], [0010]-[0012], FIGs. 2-3.)

195. The modification of the constricted convection plate in Kim with through-holes like those disclosed by Takahashi to permit servicing of the LED driver circuit board and backlight would have involved the use of one known technique to improve similar devices in the same way, and further would produce

predictable results. Takahashi's through-holes would advantageously and predictably further allow access to the LED driver circuit board beneath the shield cover with no change to the function of the shield cover, with a reasonable expectation of success.

196. Additionally, Takahashi's disclosure of through-holes for servicing allows the Kim design to maintain a leak-free cooling pathway while improving upon ease of maintenance. The combination would have constituted the simple use of one known technique, the cooling of a posterior display surface by convection of air within a constricted convection channel, (as reflected by Kim), along with the known method of using an MCPCB to improve conductive heat transfer from the BL LEDs (as disclosed by Hong), while further taking advantage of a third known method of forming deep drawn through-holes in a plate to allow servicing electronic devices associated with display (as disclosed by Takahashi). A POSITA would have expected predictable results from the combination to achieve an LCD display that was more thermally efficient and more easily serviced. A POSITA would have had a reasonable expectation of success that the combination of the three complimentary thermal efficiency and servicing techniques would work together as intended.

XI. GROUND 5: THE COMBINATION OF NA AND KIM RENDERS CLAIM 1 OBVIOUS

A. Independent Claim 1

197. It is my opinion that Na in combination with Kim renders obvious each and every limitation of Claim 1.

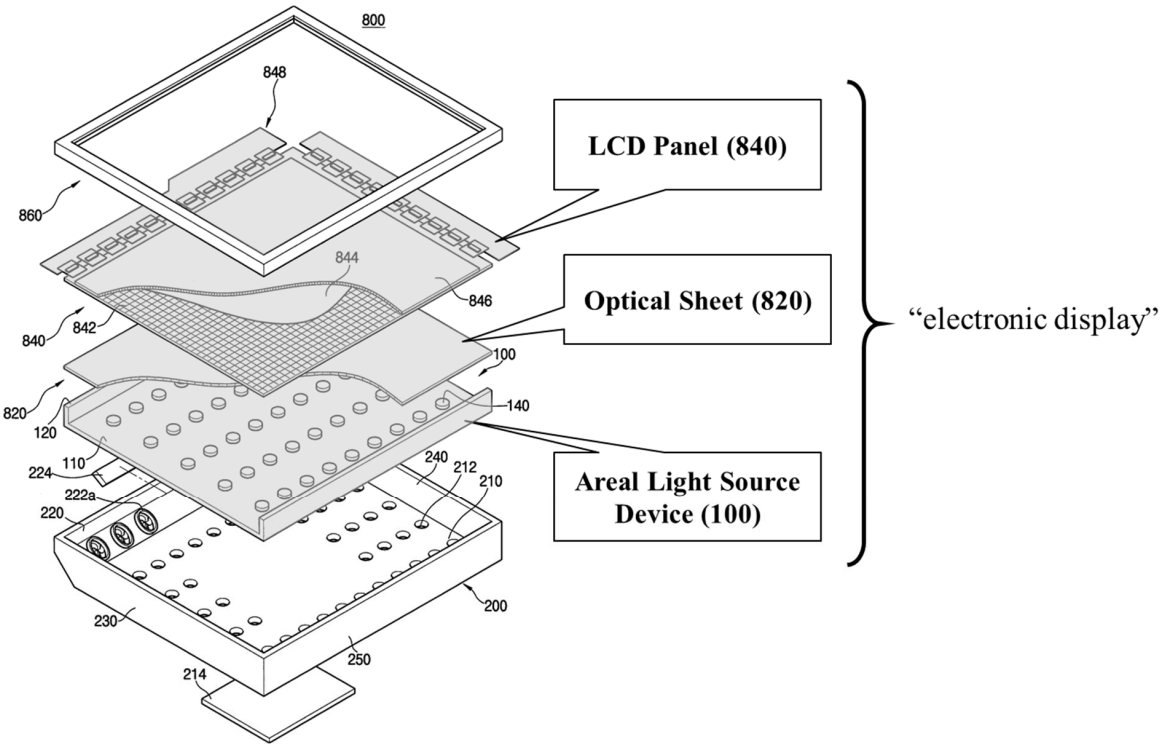
1. "A system for cooling an electronic display having a posterior display surface and contained within a housing, the system comprising:" (Claim Element 1[pre])

198. To the extent the preamble is limiting, it is rendered obvious by Na in combination with Kim.

199. Na discloses "[a] backlight unit and a liquid crystal display [LCD] device including the same," in which the backlight unit "includes a light generator and a storage container." (Ex. 1010, Abstract.) The LCD device "uses the . . . optical characteristics of liquid crystal to display an image," and "has the advantage of being very small in volume and in weight" so as to be "widely used for portable computers, communication devices, liquid crystal TVs, etc." (*Id.*, p.2.)

200. Na's LCD device includes a both a "backlight unit and a liquid crystal display panel." (*Id.*, p.3.) The "liquid crystal display panel uses the light emitted from the light generator to display an image." (*Id.*) For instance, as shown in Figure 13, a "liquid crystal display panel **840** displays an image using the light emitted from

an areal light source device **100**"[12]:

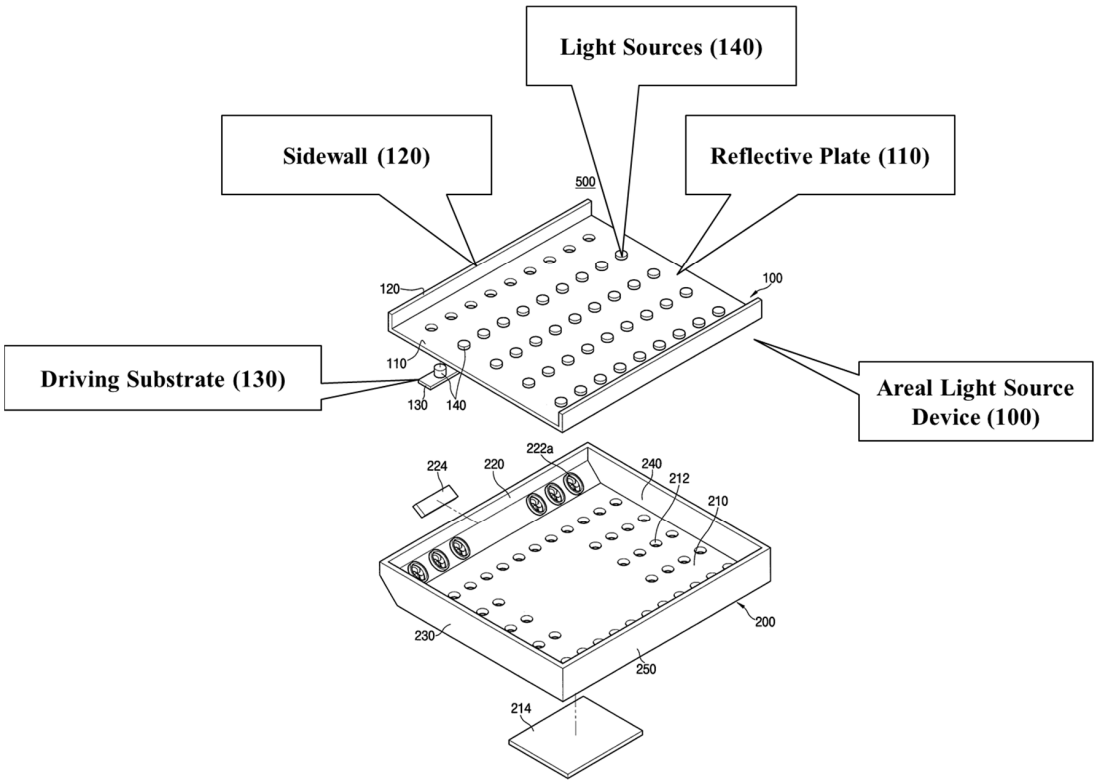


(*Id.*, p.8 & FIG. 13. (annotated)) "The liquid crystal display panel **840** includes a thin film transistor (TFT) substrate **842**, a liquid crystal **844**, a color filter substrate **846**, and a driving module **848**." (*Id.*, p.8.) "The liquid crystal display **800** may further include an optical sheet **820** for improving luminance uniformity of the light emitted from the areal light source device **100**." (*Id.*) Accordingly, the combination of the liquid display panel **840** and areal light source device **100** is an "**electronic**

[12] References to elements in Na's patent figures have been bolded.

display."

201. Na also discloses that "the areal light source device including [a] light emitting diode is used as a light generator." (*Id.*, p.4.) As shown in Figure 1, Na discloses "a backlight unit **500** includes an areal light source device **100** and a storage container **200**":

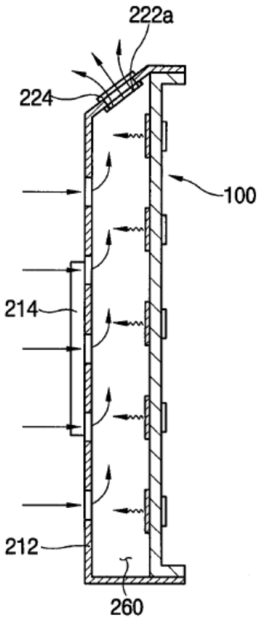


(*Id.*, p.4 & FIG. 1 (annotated).) The "areal light source device **100**" includes "a reflective plate **110**, a sidewall **120**, a driving substrate **130**, and a plurality of light emitting diode [LED] light sources **140**." (*Id.*, p.4). The LED light sources **140** "are arranged in a line on the driving substrate **130**, pass through the coupling holes **112**

and are coupled to be positioned on the upper surface of the reflective plate **110**." (*Id.*)

202. Na discloses the LED array substrate **110** of the areal light source device **100** "is driven to generate heat." (*Id.*, p.5.) As shown in Figure 3, the "temperature of the air remaining in the inner space **260** between the areal light source device **100** and the storage container **200** [shown in Figures 1 and 2] increases by the heat":

FIG. 3



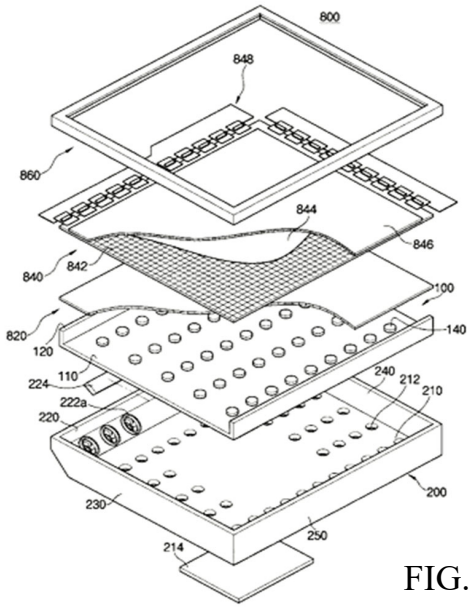


FIG. 13

(*Id.*, p.5, FIGs. 3, 13.) The bottom plate **210** of storage container 200 (not labeled in Figure 3 but shown in Figures 1 and 2) "has a rectangular flat plate shape and includes a first driving circuit unit **214** and a plurality of through-holes **212**." (*Id.*, p.4.)

203. As I explained above, I understand that the District of Delaware construed "**posterior display surface**" as used in claim 1 to mean "rear-facing surface of the display assembly." (Exs. 1011, p.1; 1012, pp. 6-8.) Figure 13 of Na shows backlight unit **100** with reflective plate **110** positioned below the liquid crystal display panel **840**. The lower surface of reflective plate **110** faces away from the LCD panel and toward storage container **200**. (Ex. 1010, FIG. 13.) As such, and imagining Figure 13 rotated to the aspect of Figure 3, it is clear that the lower (now rear) surface of reflective plate **110** forms a rear-facing surface of a "display assembly" created from the combination of aerial light source **100** and the liquid crystal display panel **840** and is thus a "**posterior display surface**" as construed by the Delaware District Court. (*Cf.* Ex. 1001, 4:66-5:5; FIGs. 3, 5B-5F.)

204. To the extent that Na does not disclose a housing that is wholly distinct from the constricted convection plate, Kim discloses such a housing. For the reasons discussed *supra*, Section VIII.A.1, Kim discloses "**a system for cooling an electronic display having a posterior display surface and contained within a housing**," in which Kim's "casing **110**" formed from "front casing **111** and a rear casing **115**" is the "**housing**."

205. Accordingly, Na in combination with Kim or renders obvious "**a system for cooling an electronic display having a posterior display surface and**

contained within a housing."

2. "a constricted convection plate placed posterior to the posterior display surface;" (Claim Element 1[a])

206. Na in combination with Kim renders obvious "**a constricted convection plate placed posterior to the posterior display surface**," as required by claim 1[a].

207. Na discloses a "**posterior display surface**" in the form of the surface of Na's backlight unit **100** for the reasons explained above with respect to the preamble of claim 1. (*See supra*, § XI.A.1.) Na further discloses "**a constricted convection plate placed posterior to the posterior display surface**."

208. As shown in Figure 1, a backlight unit **500** includes "an areal light source device **100** and a storage container **200**":

FIG. 1

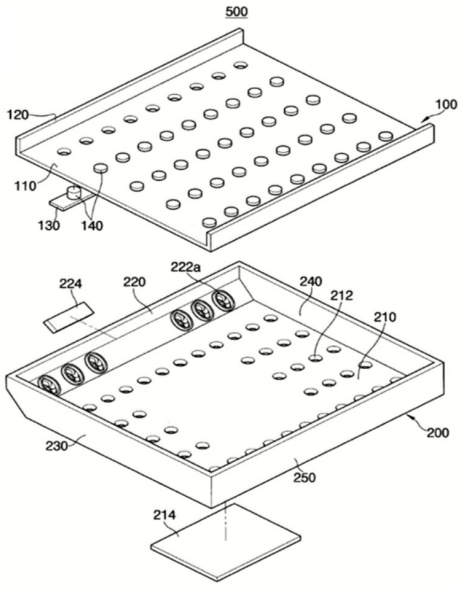
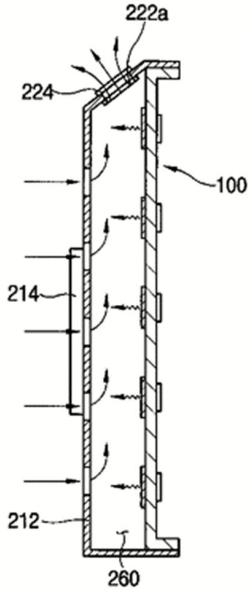


FIG. 3



(Ex. 1010, p.4 & FIGs. 1, 3.) The "areal light source device **100**" includes "a reflective plate **110**, . . . and a plurality of light emitting diode [LED] light sources **140**." (*Id.*, p.4). As discussed above, (*supra*, § XI.A.1), the rear surface of reflector plate **110** forms a **posterior display surface**.

209. As shown in Figure 1, Na provides storage container **200** which forms a cavity "inner space" **260** through which air is drawn to cool the backlight unit. "The bottom plate **210** [of storage container **200**] has a rectangular flat plate shape" (*Id.*, p.4.) The "low-temperature air cooler than the high-temperature air in the inner space **260** is introduced from the outside of the backlight unit **500** through the through-holes **212**." (*Id.*, p.5.) "A plurality of fans **222a** are formed on the first sidewall **220**." (*Id.*, p.4.) These "fans **222a** are operated to flow air from the inner space to the outside." (*Id.*) Thus, "the heat generated by the areal light source device **100** is transferred from the inner space to the outside," and "the fans **222a** function as an exhaust unit for discharging internal air." (*Id.*) Na specifically teaches that "the cooling effect is increased by a free convection phenomenon or a forced convection phenomenon resulting from the operation of the components." (*Id.*, p.9.) Therefore, it is my opinion that a POSITA would have understood that the bottom plate **210** constricts airflow in order to achieve the desired convective cooling effect.

210. Na discloses that it is possible to form holes in the side walls.

Although the through-holes can be formed on the bottom plate, "the through-holes may be further formed in the first to fourth sidewalls, or may be formed only in the first to fourth sidewalls." (Ex. 1010, p.5.) A POSITA would have understood such an embodiment to look like the following modified versions of Figures 2 and 3:

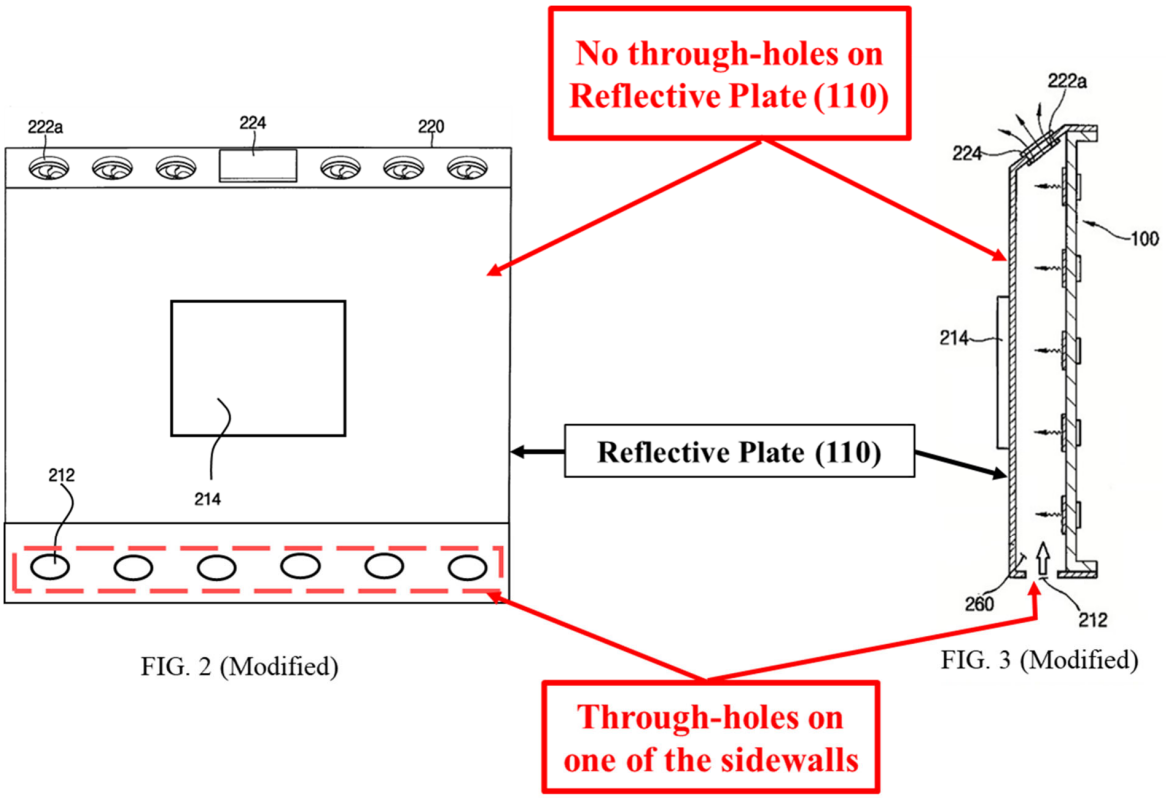


FIG. 2 (Modified)

FIG. 3 (Modified)

(*Id.*, FIGs. 2 & 3 (modified and annotated).) Accordingly, the "rectangular flat plate shape[d]" bottom plate **210** of Na's storage container **200** is a "**constricted convection plate**" that introduces and helps channel the air "in the inner space **260**" and which faces the rear-facing side of the display surface (i.e. the "**posterior display surface**" of Na's areal light source **100**), so as to be "**placed posterior to**

the posterior display surface" as required by claim 1[a]. Na's bottom plate **210** is in exactly the same "posterior position" relative to the posterior surface of the areal light source device **100** as is the constricted convection plate **30** shown relative to the display posterior **22** shown in the Figures 3 and 5B-5F of the '595 patent. (Ex. 1001, 4:66-5:5; FIGs. 3, 5B-5F).

211. Accordingly, Na in combination with Kim renders obvious "**a constricted convection plate placed posterior to the posterior display surface**."

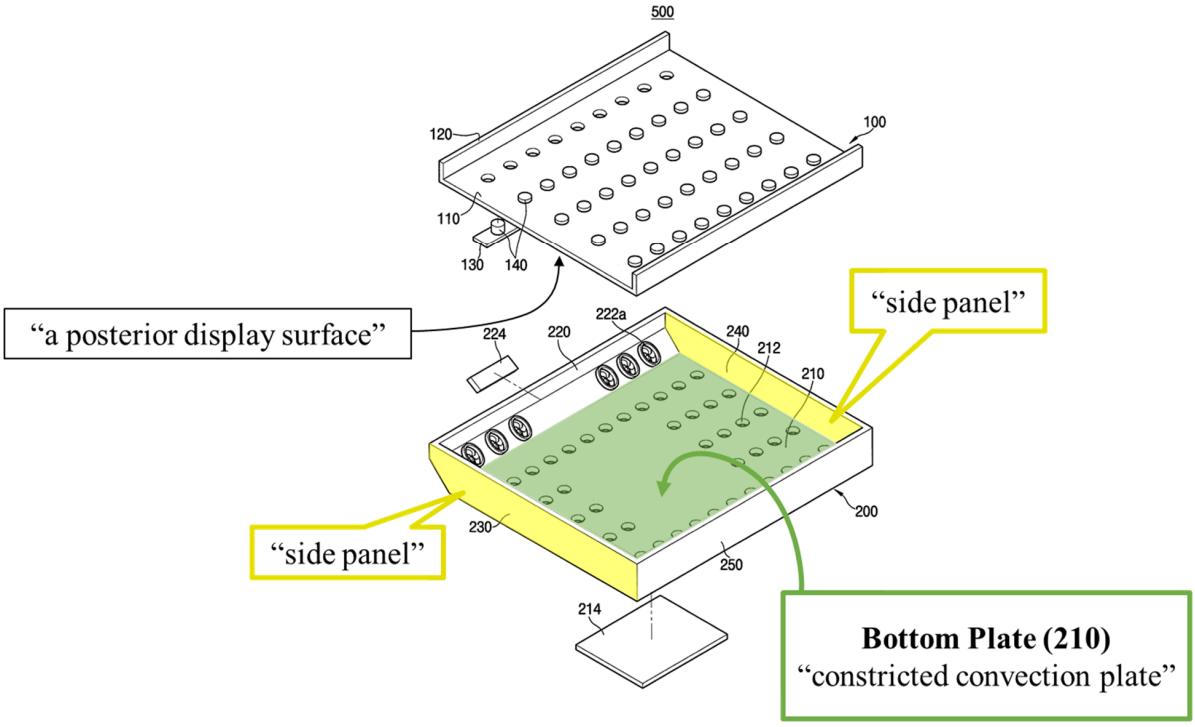
3. "two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit; and" (Claim Element 1[b])

212. Na alone or in combination with Kim discloses or renders obvious "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**," as required by claim 1[b].

213. For the reasons discussed *supra*, §§ XI.A.1 & 2, Na discloses "**a constricted convection plate**" and a "**posterior display surface**," as required by claim 1[b].

214. Na further discloses that there are "**two side panels placed adjacent to**" the rectangular bottom plate **210** of Na's storage container **200** that constitutes Na's **constricted convection plate**." In particular, as shown in Figure 1, Na

discloses that "first to fourth sidewalls **220**, **230**, **240**, and **250** extend from [i.e. are '**adjacent to**'] the edge portions of the bottom plate **210**, respectively, to form a storage space and an inner space":

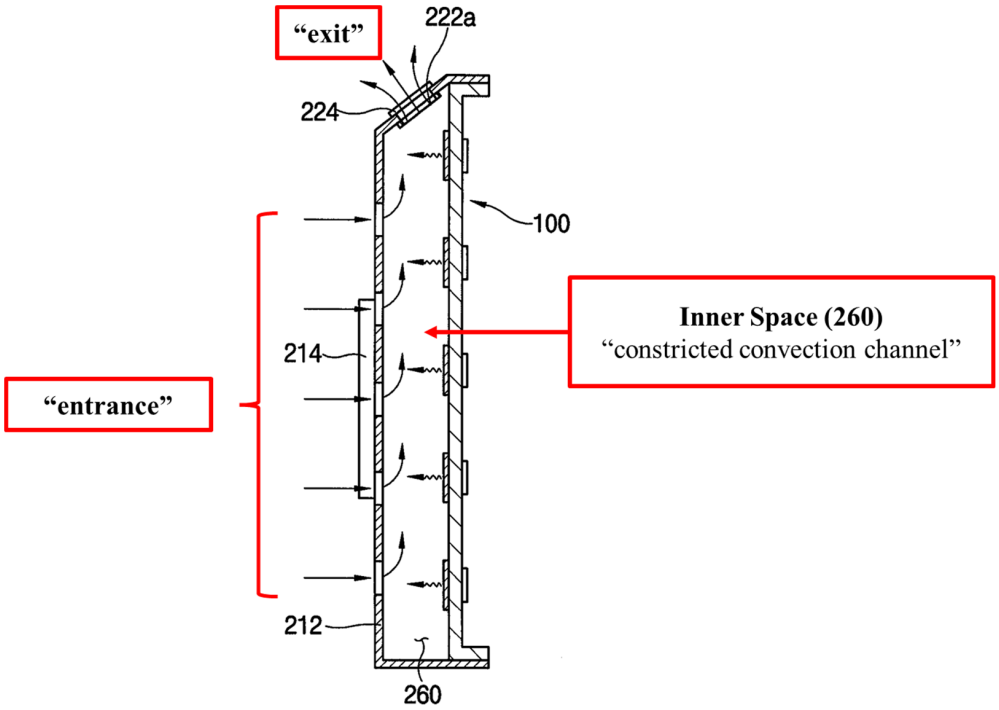


(Ex. 1010, p.4 & FIG. 1 (annotated).) The first to fourth sidewalls **220**, **230**, **240**, and **250** are four "**side panels placed adjacent to the constricted convection plate**" defined by the bottom plate **210** of Na's storage container **200**.

215. Along with the bottom plate **210**, these four sidewalls produce a "constricted channel through which air may flow to remove heat from the posterior display surface," as reflected by the arrows shown in Figure 3 in the "inner space **260**" formed between the bottom plate **210** of Na's storage container **210**, and the

rear-facing surface of Na's areal light source **100** (the "**posterior display surface**"). (*Id.*, pp.4-5; FIGs. 1-3, 13.) Thus, Kim's "inner space **260**" is a "**constricted convection channel**" as construed by the Delaware District.[13] (*See* Exs. 1011, pp.1-2; 1012, p.11.)

216. Na further discloses that the "**constricted convection channel**" reflected in inner space **260** has both an "**entrance**" and an "**exit**."



(*Id.*, p.5 & FIG. 3 (annotated).) Low-temperature air "cooler than the high-

[13] The Delaware District Court construed "constricted convection channel" to mean "constricted channel through which air may flow to remove heat from the posterior display surface." (Exs. 1011, pp.1-2; 1012, p.11.)

temperature air in the inner space **260** [the '**constricted convection channel**'] is introduced from the outside of the backlight unit **500** through the through-holes **212**." (*Id.*, p.5) The "through-holes **212** function as an intake unit [i.e. '**entrance**'] through which external air is sucked." (*Id.*, p.4.) "[F]ans **222a** are operated to flow air from the inner space to the outside [i.e. produce an '**exit**']." (*Id.*) "Thus, the heat generated by the areal light source device **100** is transferred from the inner space to the outside," and "the fans **222a** function as an exhaust unit ['exit'] for discharging internal air." (*Id.*)

217. Further, Na discloses that it is possible to form entrance through-holes only in the side walls. "In the present exemplary embodiment, although the through-holes are formed on the bottom plate, the through-holes may be further formed in the first to fourth sidewalls, or may be formed only in the first to fourth sidewalls." (*Id*., p.5.)

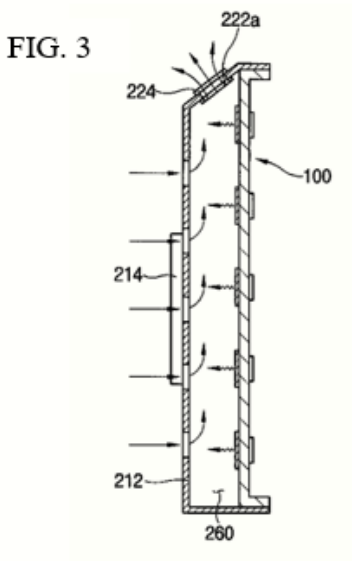
218. Accordingly, Na in combination with Kim renders obvious "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**," as required by claim 1[b].

4. "a fan placed to draw air from outside of the housing through the constricted convection channel." (Claim Element 1[c])

219. Na in combination with Kim renders obvious "**a fan placed to draw air from outside of the housing through the constricted convection channel**," as required by claim 1[c].

220. For the reasons discussed *supra*, Sections VIII.A.4 and XI.A.3, Na discloses "**a constricted convection channel**," and Kim discloses a "**housing**," as required by claim 1[c].

221. Na discloses "[a] plurality of **fans 222a** are formed on the first sidewall **220**":



(*Id.*, p.4 & FIG. 3.) These "fans **222a** are operated to flow air from the inner space ['**through the constricted convection channel**'] to the outside." (*Id.*, p.4.) The temperature of the air "in the inner space **260** rises by the heat generated in the areal light source device **100**, and the high-temperature air rises upward in the inner space

260 by the convection action, so that it is discharged by the fans **222a** to the outside." (*Id.*, p.5.) The fans also may "function as an intake unit for sucking [i.e. '**drawing**'**]** external air." (*Id.*, p.6.) Na's fan thus draws air from outside the housing and through and out of the cooling chamber (i.e. the "**constricted convection channel**").

222. Accordingly, Na in combination with Kim renders obvious "**a fan placed to draw air from outside of the housing through the constricted convection channel**," as required by claim 1[c].

5. Motivation to Combine Na and Kim

223. In my opinion, a POSITA as of March 3, 2008 would have been motivated to improve Na's "backlight unit and a liquid crystal display [LCD] device" of Na by adding an outer housing, as disclosed by Kim. (Ex. 1010, Abstract.)

224. Na, like Kim, contemplates an LCD device that "uses the . . . optical characteristics of liquid crystal to display an image," and "has the advantage of being very small in volume and light in weight" so as to be "widely used for portable computers, communication devices, liquid crystal TVs, etc." (*Id.*, p.2.) As such, Na already contemplates that its LCD display could fulfill various product embodiments each of which have unique product packaging which typically comprise front and rear housings and possibly a stand or mount. Therefore, it would be a natural extension of function to provide a housing external to the display assembly of Na

with its cooling system to form a fully packaged LCD electronic display, using Kim's outer housing and front frame.

225. Both Na and Kim are concerned with efficient cooling of the posterior display surface of an LCD display, and both references use nearly identical cooling mechanisms employing fans, entrances and exits to a cooling channel. Further, Na's first and second driving circuits **214** and **224** are exposed to ambient air. It would have been obvious to add an external housing to protect these driving units. The modification of Na's solution of cooling the rear-facing surface of an LCD display system by adding an external housing behind bottom plate **210** and further displacing the hot air generated to outside this housing, as contemplated by Kim's vented housing, would have involved the use of one known technique to improve similar devices in the same way.

226. A POSITA in March 2008 would have understood that an LCD device contained within a device like a liquid crystal TV necessarily must be contained within some kind of housing, and thus would be motivated to employ Kim's solution for removing heated air to outside that housing because it yields predictable results. A POSITA would have had a reasonable expectation of success from taking advantage not only of Na's cooling system design, but then extending those advantages via Kim's further discharge of the heated air to outside the housing

altogether. In such a configuration, a POSITA would have understood that it would be advantageous to not only to convey cooling air through the "inner space **260**" formed between the bottom plate **210** and the rear surface of Na's areal light source **100** (the "**posterior display surface**") to outside of the sidewalls of the storage container **200**, but to also displace the now heated air outside of the entire display encased by the external housing, as contemplated by Kim.

227. This combination of Na's and Kim's solutions would constitute the simple use of one known technique, the cooling of the posterior display surface of an LCD display by convection within a constricted convection channel (as reflected by Na), with the extension of that cooling technique to removing the heat to outside the housing (as reflected by Kim). Na's known technique as modified by Kim's would function in the same way as before, with predictable results. A POSITA would have had a reasonable expectation of success that the combination of the two complimentary cooling techniques would work as intended.

228. A POSITA would be motived to combine the advantages of Na's cooling system that efficiently displaces heat generated by the display assembly and discharges it outside the storage container with the advantages of Kim's solution which further discharges the unwanted heat outside the housing. To a POSITA, using the well-known cooling solutions via a constricted cooling channel of both Na

and Kim with the further extension of moving the heated air outside the housing as exemplified by Kim would simply require combination of one known element with another. And a POSITA would have had a reasonable expectation of success from a combination.

XII. GROUND 6: THE COMBINATION OF NA AND HONG RENDERS CLAIMS 4, 7 AND 8 OBVIOUS

A. Independent Claim 4

229. It is my opinion that the Na in combination with Hong renders obvious each and every limitation of claim 4. In particular, Na discloses all of the limitations of claim 4 except the use of a metal core circuit board (MCPCB) to which a plurality of LEDs are mounted on the front side, which is disclosed in Hong as discussed *infra*, Section XII.A.3. As I discuss *infra*, Section XII.A.8, a POSITA would be motivated to use MCPCBs to which a plurality of LEDs are mounted for high-power LED applications in Na's liquid crystal device and backlight unit.

230. Accordingly, it is my opinion that Na in combination with Hong renders obvious each and every limitation of independent claim 4.

1. "A liquid crystal display (LCD) comprising:" (Claim Element 4[pre])

231. To the extent the preamble of claim 4 is limiting, Na in combination with Hong renders obvious "**a liquid crystal display (LCD)**."

232. The title of Na is "Backlight Unit and **Liquid Crystal Display** Device

Including the Same." (Ex. 1010, p.1 (emphasis added).) Similarly, Na's Field of the Invention discloses "[t]he present invention relates to a backlight unit and a **liquid crystal display** device including the same, and more particularly, to a backlight unit capable of improving a cooling effect and a liquid crystal display device including the same." (*Id.*, p.2 (emphasis added).) Indeed, Na repeatedly and frequently discloses that its invention is directed to such an "**liquid crystal display (LCD)**." (*See id.*, pp. 2-4, 6, 8-9, FIGs. 13-14.)

233. Accordingly, Na in combination with Hong renders obvious a "**a liquid crystal display (LCD)**" as required by the preamble of claim 4.

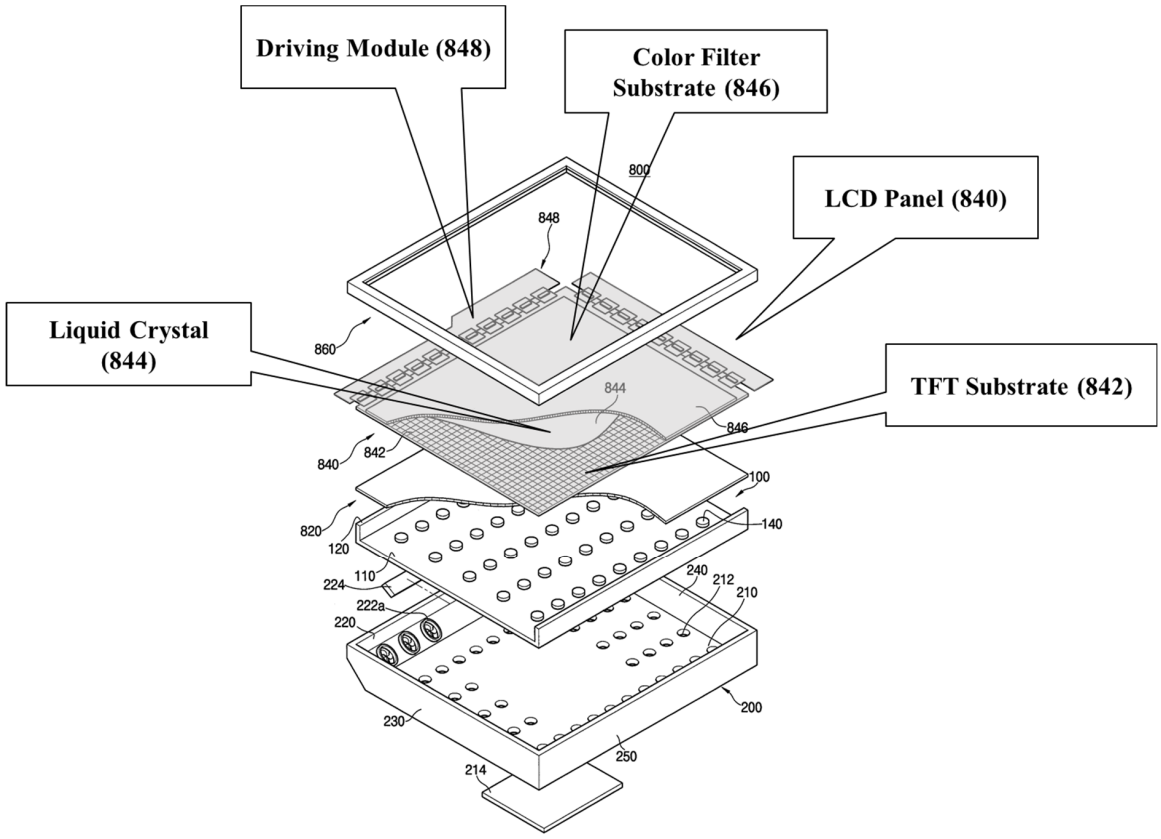
2. "a liquid crystal stack;" (Claim Element 4[a])

234. Na alone or in combination with Hong discloses or renders obvious "**a liquid crystal stack**" as required by claim element 4[a].

235. A "**liquid crystal stack**" is a liquid crystal display panel, which includes two glass sheets surrounding an LC layer, one glass sheet containing a TFT array and the other a color filter array, and the so-called cell laminated front and rear with polarizer films.[14] Na discloses such a liquid display panel/liquid crystal stack.

[14] Notably the specification of the '595 patent does not define the term "liquid crystal stack," but states the "display 10 may be the front glass plate of a liquid crystal display stack." (Ex. 1001, 9:19-21.)

Na discloses "the present invention includes a backlight unit and a **liquid crystal display panel**." (Ex. 1010, p.3 (emphasis added).) Na further discloses that "[t]he liquid crystal display panel uses the light emitted from the light generator to display an image." (*Id.*) Na's Figure 13 illustrates "the liquid display panel **840**", which Na discloses can include "a thin film transistor (TFT) substrate **842**, a liquid crystal **844**, a color filter substrate **846**, and a driving module **848**" (i.e. the "**stack**"):



(*Id.*, p. 8; FIG. 13 (annotated).)[15]

236. Accordingly, Na in combination with Hong renders obvious a "**liquid crystal stack**" as required by claim element 4[a].

3. "a backlight assembly behind the liquid crystal stack and comprising: a metal core printed circuit board (PCB) having front and back sides; a plurality of LEDs mounted on the front side of the PCB; a posterior surface on the rear side of the PCB;" (Claim Element 4[b])

237. Na in combination with Hong renders obvious the requirement of claim element 4[b] of "**a backlight assembly behind the liquid crystal stack and comprising: a metal core printed circuit board (PCB) having front and back sides; a plurality of LEDs mounted on the front side of the PCB; a posterior surface on the rear side of the PCB**."

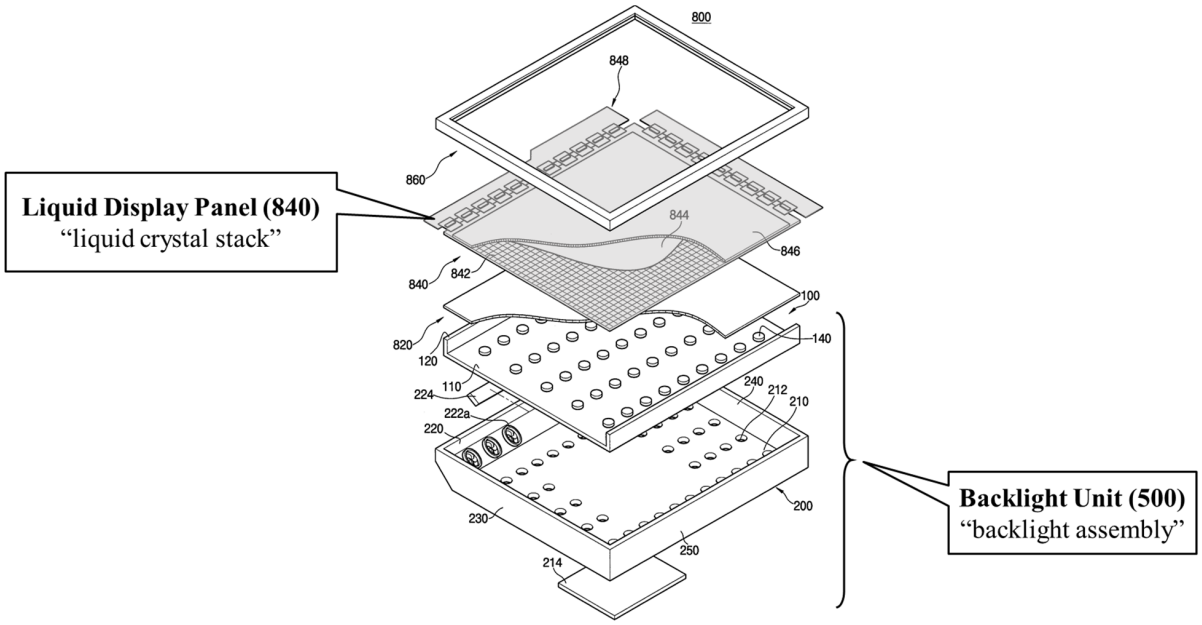
238. Na discloses a "**a backlight assembly behind the liquid crystal stack**." Indeed, the title of Na is "**Backlight Unit** and Liquid Crystal Display Device Including the Same." (Ex. 1010, p.1 (emphasis added).) Na discloses that "a liquid crystal display device **800** includes a backlight unit **500**, a liquid crystal display panel **840**, and a chassis **860**." (*Id.*, p.8 & FIG. 13.) "The liquid crystal display panel **840**

[15] Notably, the specification of the '595 patent does not define the term "liquid crystal stack," but states the "display **10** may be the front glass plate of a liquid crystal display (LCD) stack." (Ex. 1001, 9:19-21.)

displays an image using the light emitted from an areal light source device **100**." (*Id.*, p.8.) "The liquid crystal display panel **840** includes a thin film transistor (TFT) substrate **842**, a liquid crystal **844**, a color filter substrate **846**, and a driving module **848**." (*Id.*) "The liquid crystal display **800** may further include an optical sheet **820** for improving luminance uniformity of the light emitted from the areal light source device **100**." (*Id.*)

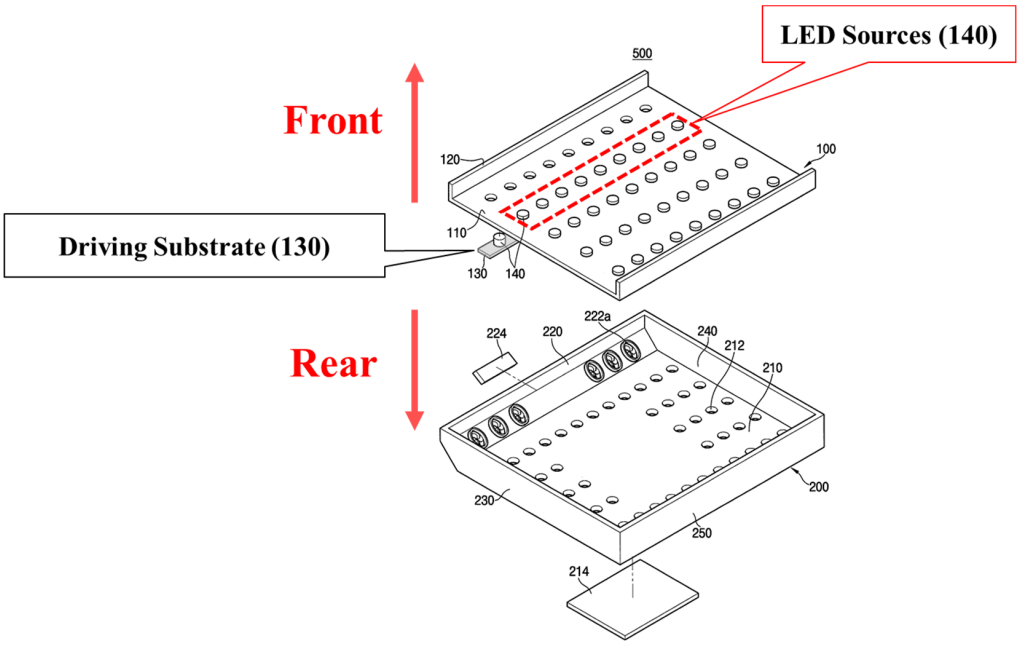
239. Na discloses that its "backlight unit **500**" includes "an areal light source device **100** and a storage container **200**." (*Id.*, p.4 & FIG.1.) "The areal light source device **100** includes a reflective plate **110**, a sidewall **120**, a driving substrate **130**, and a plurality of light emitting diode light sources **140**." (*Id.*) Accordingly, Na's "backlight unit" is the claimed "**backlight assembly**."

240. Na further discloses that its backlight unit is "**behind**" its liquid crystal display (i.e. "**liquid crystal stack**"). As shown in Figure 13, the "backlight assembly **500**" that includes "areal light source **100**" within sidewall **120** is located immediately beneath (i.e. "**behind**") the liquid display panel **840** (i.e. the "**liquid crystal stack**") and its "optical sheet **820**":



(*Id.*, p.8, FIG. 13 (annotated).) Accordingly, Na discloses a "**a backlight assembly behind the liquid crystal stack**."

241. Na discloses that "driving substrate **130** is arranged side by side at the lower part of the reflective plate **110**," and "[a] drive power source is applied to the driving substrate **130** to illuminate the light emitting diode light sources **140**." (*Id.*, p.4.) As reflected in Figure 1, "[t]he light emitting diode light sources **140** [i.e. a '**plurality of LEDs**'] are arranged in a line on driving substate **130**, pass through the coupling holes **112** and are coupled to be positioned on the upper surface of the reflective plate **110**":



(*Id.*, p.4, FIG. 1 (annotated).) In being "arranged in a line on driving substrate **130**," and as clearly illustrated in Figure 2, the plurality of LEDs **140** necessarily are "**mounted**" on the "**front side**" of driving substrate 130 (the "**PCB**"). Na teaches that the "driving substrate **130** of the areal light source device **100** is driven to generate heat." (*Id.*, p7.) Because it illuminates the LED sources **140** and generates heat, a POSITA would have understood Na's "driving substrate **130**" to be a circuit board. As illustrated in Figure 2, the driving substrate **130** has "**front and back sides**," with LED sources attached to the **front side** driving substrate 130 immediately beneath (i.e. **behind**) the LCD panel (the **LCD stack**). (*Id.*, FIG. 2.)

242. Further, because Na's driving substrate **130** is a multifunctional component that performs a variety of tasks (e.g. illuminating the LEDs and

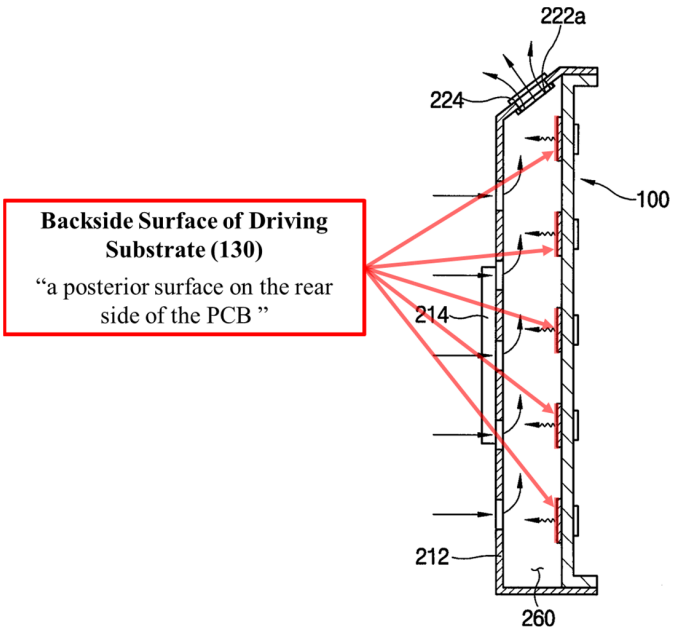
connecting to other electronic components like driving circuit unit **224** (*see id.*, p.4 & FIG. 2), a POSITA would have understood that driving substrate **130 is a printed circuit board** ("PCB"). Accordingly, Na discloses "**a printed circuit board (PCB) having front and back sides**."

243. I further note that the '595 patent states:

> The PCB may comprise a metal core PCB and **the posterior surface of the PCB** may be metallic so that air within the constricted convection channel may cool the **metallic posterior surface** (and subsequently the backlight assembly) more easily and efficiently.

(Ex. 1001, 4:60-65.) Accordingly, a POSITA would have understood from the '595 patent's disclosure that **the rear outmost surface** of a PCB is the recited "**posterior surface**," and hence Na discloses "**a posterior surface on the rear side of the PCB**."

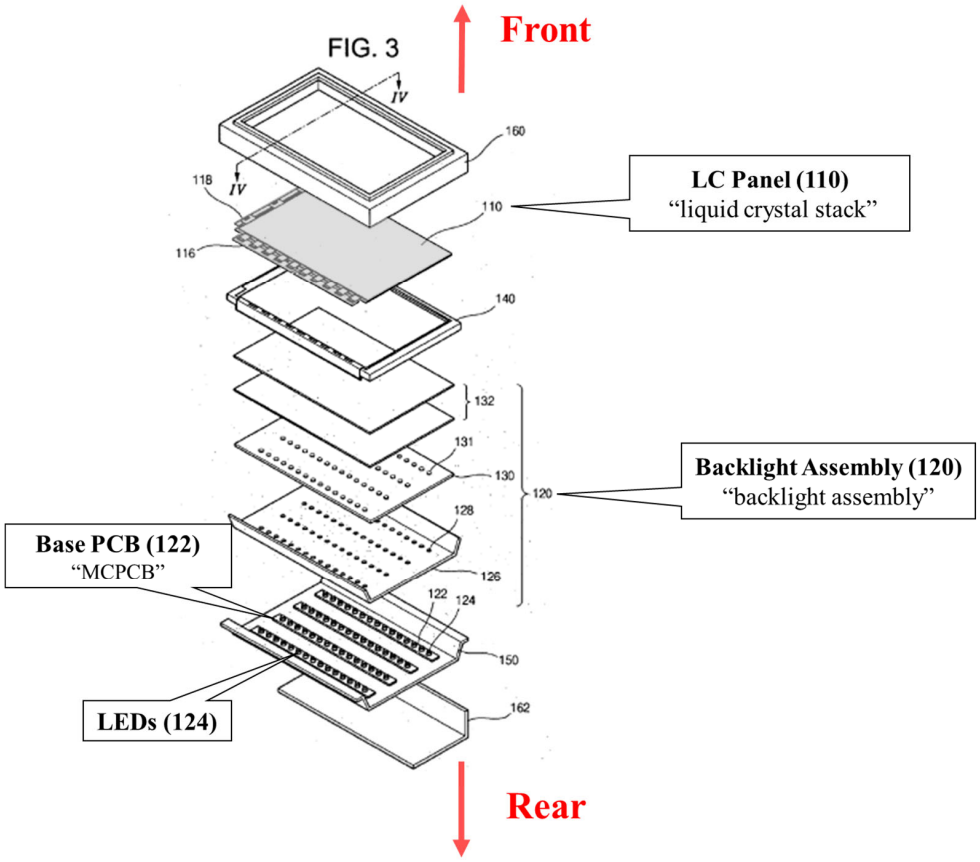
244. In particular, the "**posterior surface**" in Na corresponds to the outmost surface of the rear side of the portion of driving substrate **130** facing "the inner space **260**," which is illustrated in Figure 3 as the space located between the areal light source device **100** and the storage container **200** with its bottom plate **210** [labeled in Figures 1 and 2 but not in Figure 3]:



(*Id.*, p.5 & FIG. 3 (annotated).) The posterior surface of the driving substrate **130** thus faces the bottom plate **210** that is the "**constricted convection plate**" described above in conjunction with the combination of Na and Kim and claim element 1[b].

245. Hong discloses an LCD device that includes "a backlight assembly **120** and a liquid crystal panel **110** [which] may be disposed over an inner surface of a bottom case **150**." (Ex. 1006, ¶[0025].) As shown in annotated Figure 3 below, the backlight assembly **120** includes a base PCB **122**, which "is placed on an inner surface of the bottom case **150**[.]" (*Id.*, ¶[0033].) "The peripheral portion of the liquid crystal panel **110** is placed on the main supporter **140**," and "[t]he top cover **160** surrounds the liquid crystal panel **110**." (*Id.*) A POSITA would have understood this disclosure to mean that the backlight assembly **120** is necessarily

disposed behind the liquid crystal panel **110**:



(Ex. 1006, ¶¶[0029], [0033], FIG. 3 (annotated).) Therefore, Hong discloses a backlight assembly **120** that is "**behind the liquid crystal stack**."

246. Hong discloses in reference to Figure 3 that "[t]he backlight assembly **120** includes a plurality of LEDs **124**," which "may be arranged on a plurality of base PCBs **122**." (*Id.*, ¶[0029], Fig. 3.) Hong discloses that:

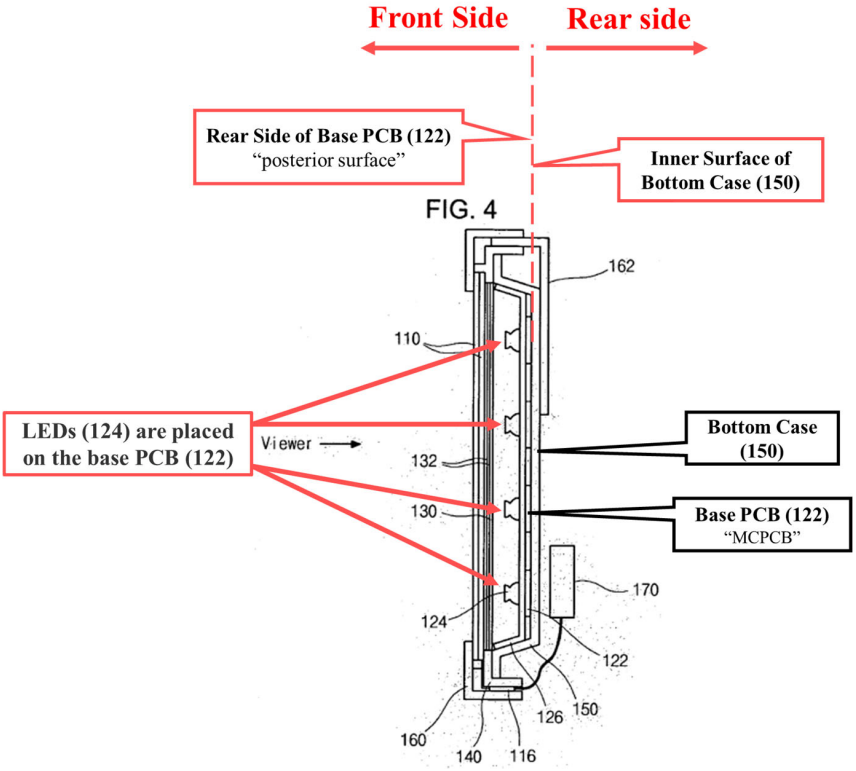
> **The base PCB 122 may include a MCPCB (metal core printed circuit board)** which may effectively absorb and

transfer heat produced at the LED **124**.

(*Id*., ¶[0029] (emphasis added).)

247. Hong discloses that "the base PCB **122** is placed on an inner surface of the bottom case **150**, and the LEDs **124** are placed on the base PCB **122**." (*Id.*, ¶[0033].) Thus, Hong discloses a "**back side**" of the PCB, which faces the inner surface of the bottom case **150** and a "**front side**" of the PCB, on which a plurality of LEDs **124** are mounted. Accordingly, Hong discloses "**a metal core printed circuit board (PCB) having front and back sides**."

248. Hong likewise discloses "**a plurality of LEDs mounted on the front side of the PCB**." Hong discloses that "[t]he backlight assembly **120** includes a plurality of LEDs **124**" and that "[t]he LEDs **124** may be arranged on a plurality of base PCBs **122**." (*Id.*, ¶[0029.) Hong further discloses that "the base PCB **122** is placed on an inner surface of the bottom case **150**, and the LEDs **124** are placed on the base PCB **122**." (*Id.*, ¶[0033].) A POSITA would have understood this to mean that the LEDs **124** are mounted on the "**front side of the PCB**," as shown in annotated Figure 4:



(FIG. 4 (annotated).) Since each one of Hong's "backlight assembly **120** includes a plurality of LEDs **124**" which "may be arranged on a plurality of base PCBs **122**," Hong discloses "**a plurality of LEDs mounted on the front side of the PCB**." (*Id.*, ¶[0029].)

249. Similarly, Hong's metal core PCB has a "**back side**," which is the side of the PCB **122** which "is placed on an inner surface of the bottom case **150**" and a "**front side**," which is the surface of the PCB **122** on which the LEDs **124** are mounted, as shown in Figure 4. (*Id.*, ¶[0033].)

250. Accordingly, Na in combination with Hong discloses or renders

obvious the requirement of claim element 4[b] of "**a backlight assembly behind the liquid crystal stack and comprising: a metal core printed circuit board (PCB) having front and back sides; a plurality of LEDs mounted on the front side of the PCB; a posterior surface on the rear side of the PCB**."

4. "a constricted convection plate placed behind the posterior surface of the PCB, defining a constricted convection channel having an entrance and an exit; and" (Claim Element 4[c])

251. Na in combination with Hong renders obvious "**a constricted convection plate placed behind the posterior surface of the PCB, defining a constricted convection channel having an entrance and an exit**" as required by claim element 4[c].

252. Na discloses "**two side panels placed adjacent to the constricted convection plate and the posterior display surface, defining a constricted convection channel having an entrance and an exit**" for the same reasons provided in the discussion above with respect to claim element 1[b] in the Ground 5 combination of Na and Kim. (*See supra*, § XI.A.3.) And Na and Hong each also discloses **a PCB** and a "**posterior surface of the PCB**" for the reasons discussed above in claim elements 4[a] and 4[b]. (*See supra*, §XII.A.2 & 3.)

253. Accordingly, Na in combination with Hong renders obvious "**a constricted convection plate placed behind the posterior surface of the PCB,**

defining a constricted convection channel having an entrance and an exit" as recited in claim element 4[c].

5. "the fan positioned to draw air through the constricted convection channel." (Claim Element 4[d])

254. It is my opinion that Na in combination with Hong renders obvious "**a fan positioned to draw air through the constricted convection channel**," as required by claim 4[d] of the '595 patent, for the reasons provided in the discussion of the nearly identically worded limitation 1[c]. (*See supra*, § XI.A.4.)

255. For these reasons, claim 4 is obvious over Na in combination with Hong.

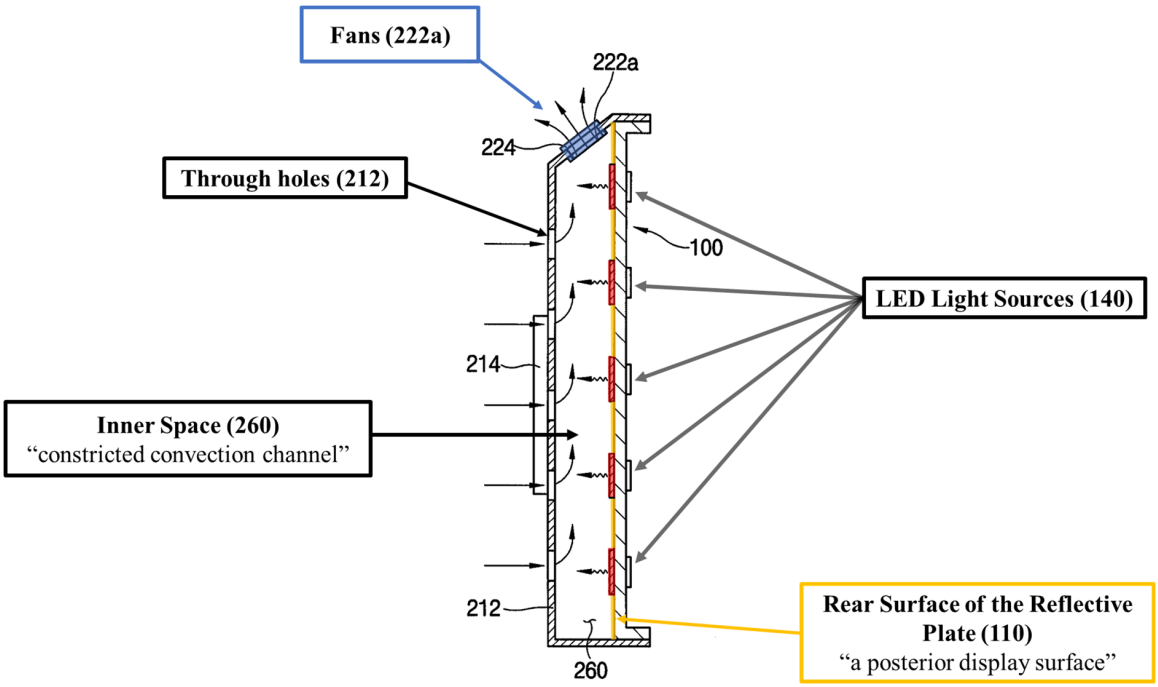
6. "The LCD from claim 4 wherein: the fan is placed near the exit of the constricted convection channel;" (Claim 7)

256. The combination of Na and Hong renders obvious the limitations of claim 4 for the reasons discussed above. (*See supra*, §§ XII.A.1-5.) Na further discloses the limitations of claim 7 of "**the fan is placed near the exit of the constricted convection channel**."

257. As discussed above with respect to limitations 1[b]-[c], Na discloses a "**fan**," and an "**exit**" of a **"constricted convection channel**." (*See supra*, §§ XI.A.3 & 4.)

258. Na discloses its "plurality of **fans 222a** are formed on the first sidewall

220", as shown in Figure 3:



(*Id.*, p.4 & FIG. 3 (annotated).) These "fans **222a** are operated to flow air from the inner space [**260**, i.e. the "**constricted convection channel**"] to the outside." (*Id.*, p.4.) Na further discloses that the temperature of the air "in the inner space **260** rises by the heat generated in the areal light source device **100**, and the high-temperature air rises upward in the inner space **260** by the convection action, so that it is **discharged by the fans 222a to the outside**." (*Id.* (emphasis added).) That is, "the fans **222a** function as an exhaust unit for discharging internal air." (*Id.*)

259. Given that "the fans **222a** function as an exhaust unit" and are located on the sidewall **220** exactly where the high-temperature air "is discharged . . . to the outside," (*id.*) they necessarily are "**placed near the exit of the constricted**

convection channel." Indeed, they are the relevant "**exit**."

260. While the through-holes are shown in the bottom plate in Figure 3, Na also discloses that "the through-holes may be further formed in the first to fourth sidewalls, or may be formed only in the first to fourth sidewalls." (*Id*., p.5.) In those situations where the through-holes are located on the sidewalls, the fans are undoubtedly located near such through-holes which act as exits of the constricted convection channel.

261. Accordingly, Na in combination with Hong renders obvious "**the fan is placed near the exit of the constricted convection channel**," as required by claim 7.

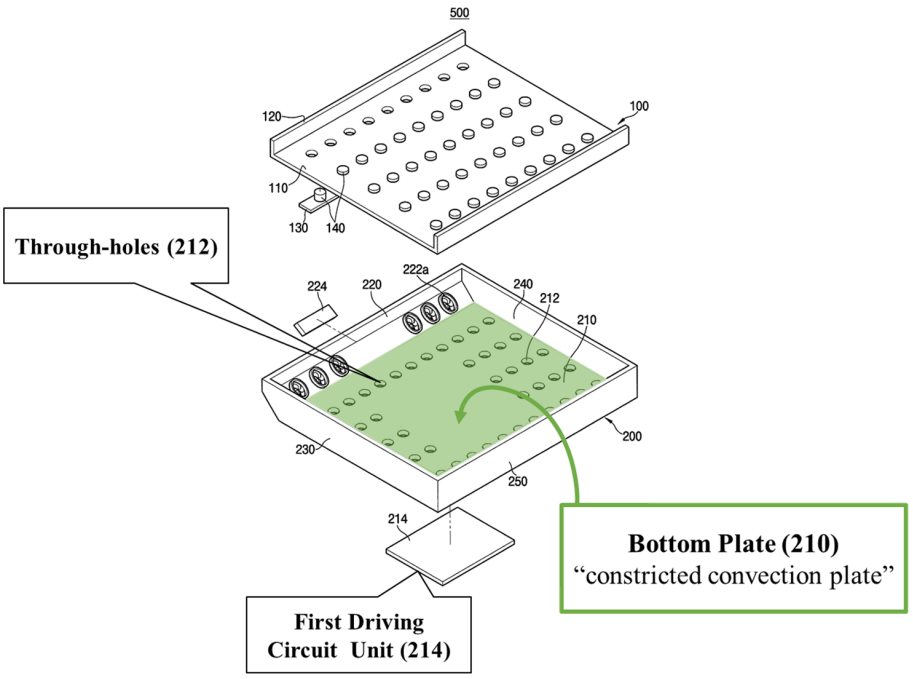
7. "The LCD from claim 4 further comprising: a plurality of access apertures through the constricted convection plate;" (Claim 8)

262. The combination of Na and Hong renders obvious the limitations of claim 4 for the reasons discussed above. (*See supra*, §§ XII.A.1-5.) Na and Hong further discloses the limitations of claim 8.

263. As disclosed above in the discussion of limitation 1[c] with respect to the combination of Na and Kim in Ground 5, Na discloses a **"constricted convection plate**" in the form of "bottom plate **210**." (*See supra*, § XI.A.2.)

264. As reflected by Figure 1, Na discloses "a bottom plate **210** [that] has a

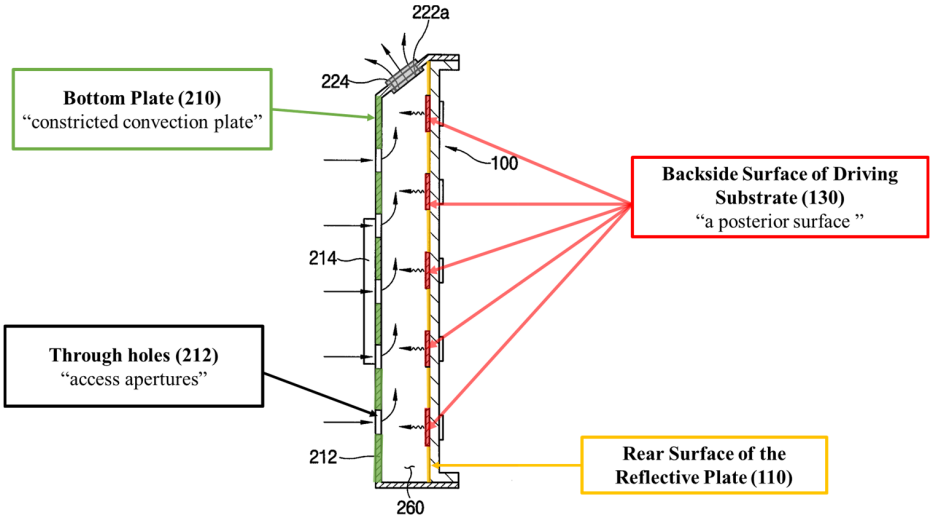
rectangular flat plate shape, and includes a first driving circuit unit **214** and a plurality **of through-holes 212**":



(*Id.*, p.4 (emphasis added) & FIG. 1 (annotated).) These "through-holes **212** are formed in portions except for the portion where the first driving circuit unit **214** is disposed, and are formed **through the bottom plate 210** [i.e. '**through the constricted convection plate**']." (*Id.*, p.4 (emphasis added).) Na discloses that "[a]ir may move through the through-holes **212**," and "the through-holes **212** may function as an intake unit through which external air is sucked." (*Id.*)

265. Inasmuch as these through-holes provide "**access**" for at least air "**through the constricted convection plate**," they are to a POSITA, like the example in the specification of the '595 patent discussed above (*supra* ¶ 61), "**access**

apertures." A POSITA would recognize these through-holes could also be placed at locations or expanded to accommodate other purposes, such as servicing electrical components and hardware associated with the backlight unit and/or the LCD display, such as the internal parts of the fans **224** (colored blue), the backlight driving substrate **130** (i.e. PCB) (colored green), or a rear surface of the reflective plate **110** (colored orange) as illustrated in annotated Figure 3:



(*Id.*, FIG. 3 (annotated).)

266. Accordingly, Na in combination with Hong renders obvious **"[t]he LCD from claim 4 further comprising: a plurality of access apertures through the constricted convection plate**" as required by claim 8 of the '595 patent.

8. Motivation to Combine Na and Hong

267. In my opinion, a POSITA as of March 3, 2008 would have been motivated to use Na's "backlight unit capable of improving a cooling effect and a

liquid crystal display device including the same" (Ex. 1010, p.2), and to modify its disclosed use of a "driving substrate 130" on which are mounted LEDs, to adapt the display for a higher power LED backlight by taking advantage of Hong's MCPCB which provides a more thermally efficient design for heat dissipating components. (Ex. 1006, ¶¶[0029], [0033].)

268. Both Na and Hong use printed circuit boards located underneath a LCD panel containing a plurality of LEDs to power the relevant backlight units. (Ex. 1010, p. 4 & FIGs 1-3; Ex. 1006, ¶¶[0025], [0029], [0033].) While Na discloses an efficient arrangement of fans and through-holes providing entrances and exits for air to enter to and from a constricted convection panel through the housing of the LCD device to remove the heat generated by heat-dissipating components of the backlight unit (Ex. 1010, pp.4-5; FIGs. 1-3 & 13), Hong discloses an MCPCB with LEDs configured to produce "effectively absorb and transfer heat produced at the LED **124**." (Ex. 1006, ¶[0029].) As discussed in ¶¶ 55-56 above, the use of a metal core printed circuit board would be a well-known design choice subject to technical and cost considerations. A POSITA would have been aware of the benefits associated with using an MCPCB to reduce LED junction temperatures. In particular, one of the dominant suppliers at the time, Lumileds, recommended their use when specifying high power (~>1W) LEDs in an application. (Ex. 1023.) In fact,

Lumileds indicates that all Level 2 Luxeon products at least as of 2006 were mounted on an MCPCB. (Ex. 1024, p.2.) Knowing the importance of controlling LED junction temperature by providing high conductivity thermal pathways, a POSITA would have been motivated to consider the use of MCPCBs. Na's and Hong's solutions thus are complementary and aimed at producing more thermally efficient LCD devices that reduce undesirable heat build-up in the backlight unit.

269. The substitution of Na's driving substrate **130** to which LEDs are mounted with Hong's metal core PCB with multiple LEDs mounted to it would have involved the use of one known technique to improve similar devices in the same way, and further would produce predictable results. A POSITA in March 2008 would be motivated to employ Na's solution cooling the backlight unit via the use of a constricted convection channel employing fans and through-holes, along with Hong's more thermally efficient MCPCB, because the combination combines known prior art methods to yield predictable results and there would have been an expectation of success from using the combination to improve backlight performance and LED operating life. A POSITA would have had a reasonable expectation of success from taking advantage not only of Na's use of the constricted convection channel to exhaust air heated by the electrical components of the backlight unit, but also Hong's more efficient use of a metal core PCB that to reduce

LED operating temperatures with a further advantage of reducing the thickness of the LCD display. (Ex. 1006, ¶[0040].) A POSITA could have combined these two known solutions with no change in their respective functions, and the combination would yield predictable results.

270. A POSITA in March 2008 would have appreciated that a metal core PCB is more suitable for use in display systems with high-power backlights. Compared to a standard PCB, the roughly 10x higher thermal conductivity of an MCPCB would greatly aid in removing heat from that LED back (which is one of the very aims of Na's cooling mechanism). A POSITA thus would have understood that it would be advantageous to use Na's methodology for employing a constricted convection channel to cool the backlight unit, by modifying it with Hong's MCPCB that is more suitable for use with the LEDs. The combination would have constituted the simple use of one known technique, the cooling of the posterior display surface of an LCD display by convection of air within a constricted convection channel, (as reflected by Na), and by another known technique, the utilization of a metal core LED PCB, (as disclosed by Hong), with predictable results that the combination would make the LCD display more thermally efficient. Na's cooling methodology would function in the same way as before but, by substitution of a metal core circuit board for the standard PCB, would be benefit from reduced heat stress on the LED

backlight. A POSITA would have had a reasonable expectation of success that the combination of the two complimentary thermal efficiency techniques would work together as intended. And a POSITA would have had a reasonable expectation of success from such a simple substitution of one known technique for the other.

271. Further, because Na's "driving substrate **130** illuminates the LEDs **140**, a POSITA would recognize Na's driving substrate **130** could advantageously be a metal core PCB ("MCPCB"), which is more suitable to systems that dissipate a lot of energy (like an LED device) and improve cooling of the PCB and LED, a stated aim of Na's cooling mechanism.

XIII. NO SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

272. I understand from counsel that the Patent Owner in the underlying ITC investigation has not yet identified any evidence with respect to secondary considerations of non-obviousness.

273. To the extent the Patent Owner cites any evidence of sales or any praise or any industry recognition of products that the Patent Owner asserts to implement the claimed invention, I am not aware of any information demonstrating that any purported increased sales, commercial success, praise, or any other secondary factor (that the Patent Owner may assert) was a result of the particular features recited in the '595 patent's claims. Since the Patent Owner has not yet identified any evidence

of secondary considerations, the Patent Owner cannot demonstrate that the limitations of the claimed invention in particular, as opposed to other features of the products at issue, were the factors that caused any increased sales, praise, or any other asserted secondary considerations.

274. Thus, based on my review of the evidence to date, I can summarize my opinions regarding any alleged secondary considerations of non-obviousness relating to the ’595 Patent, as follows:

275. *No commercial success of the claimed invention*. The Patent Owner has not cited any evidence of particular commercial success of products embodying the ’595 patent as opposed to products that do not embody the ’595 patent. The Patent Owner has not cited any evidence that any commercial success of any products is particularly a result of the claimed inventions recited in the ’595 patent’s claims and not due to any other facts.

276. *No long-felt but unsolved need*. The Patent Owner has not cited any evidence of any long-felt need that remained unsolved in the prior art before the ’595 patent. To the contrary, as discussed above, the prior art solved the problems that the ’595 patent purported to address.

277. *No failure of others*. The Patent Owner has not cited any evidence of anyone who tried, but failed, to solve the problems addressed by the ’595 patent.

As shown by my analysis above, there existed prior art references that successfully disclosed and rendered obvious the subject matter claimed by the ’595 patent.

278. *No copying of the claimed invention*. The Patent Owner has not cited any evidence that any other party (including Facebook or third parties) ever copied from the ’595 patent and its claimed invention.

279. *No unexpected results of the claimed invention*. The Patent Owner has not cited any evidence of unexpected results achieved by the ’595 patent’s claimed invention. To the contrary, the prior art disclosed the predictable, expected results that show why the ’595 patent’s claims are obvious as discussed in my Declaration.

280. *No praise for the claimed invention*. The Patent Owner has not cited any evidence of praise for the claimed invention recited in the ’595 patent.

281. *No surprise or skepticism at the claimed invention*. The Patent Owner has not cited any evidence that observers were surprised by, or skeptical of, the claimed invention recited in the ’595 patent.

282. *No departure from the wisdom of the prior art*. The Patent Owner has not cited any evidence that the claimed inventions of the ’595 patent departed from the wisdom of the prior art. The ’595 patent claims subject matter that was already present in the prior art, including in the references discussed in my analysis above.

283. Moreover, with respect to the considerations discussed above, I also

refer to and incorporate my opinions stated throughout this Declaration, including my analysis showing that the '595 patent is directed to techniques known in the prior art and does not provide any inventive technology.

284. To the extent the Patent Owner at a later date cites or provides any other evidence regarding secondary considerations, including any expert opinions, I reserve the right to supplement my analysis and opinions to comment on it.

XIV. CONCLUSION

285. In my opinion, based on my review of the '595 patent, the materials referenced herein, and my knowledge of what a person of ordinary skill in the art would have known at and before the '595 patent's priority date about the technology at issue, a POSITA would have understood all of the limitations of the challenged claims 1, 4, 7, and 8 to be present and described in each of the prior art references forming the six grounds discussed herein.

286. Accordingly, it is my opinion that challenged claims 1, 4, 7, and 8 should be found unpatentable.

287. Furthermore, I reserve the right to supplement my opinions in the future to respond to any arguments or positions that the Patent Owner may raise, taking account of new information as it becomes available to me.

288. I hereby declare that all statements made herein of my own knowledge

are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Declaration of Robert Smith-Gillespie in Support of
Petition for *Inter Partes* Review of
U.S. Patent No. 8,854,595

Respectfully submitted,

Dated: November 21, 2022

Robert Smith-Gillespie